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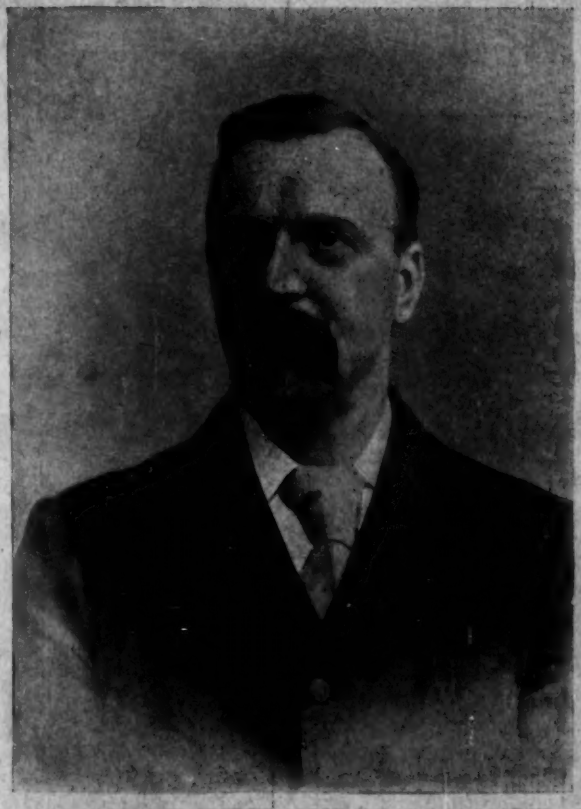

MR. HARRY COWARD,
The new President of the N.U.T.

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THE

PRACTICAL TEACHER

A MONTHLY MAGAZINE AND REVIEW

FOR THE SCHOOL-ROOM AND THE STUDY

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BY MANY HANDS.

"Quot homines, tot sententiæ."

PASSING through Paris not long ago an English teacher stared to find upon the hoardings the advertisement of a school for cabmen. Perhaps it is true that the Parisian *cocher* needs instruction in driving and managing a horse more than any other cabby in the world, except the Neapolitan *vetturino;* but, none the less, it came with a shock to find that anywhere anybody had ever thought of putting a cabdriver to school! So wedded are we to the common and time-honoured narrow scopes of teaching, that it seems almost as startling to find that courses of lectures in "the history, law, finance, and practice of fire insurance" are to be given at the London School of Economics, where similar courses in life assurance matters have for some time past been established, indeed. Quite lately, also, the London Chamber of Commerce instituted a series of lectures on marine insurance; and the School of Economics has provided courses in banking law, accountancy, and railway administration. Now, for the first time in the history of English universities, insurance has been placed upon the same plane as any other branch of university study; and thus another flout in the face of the ancient and monkish curriculum has been given. Surely we are modernising and practicalising at great speed! Surely, if this alarming kind of thing goes on, the last refuges of Greek iambics will be invaded by the vulgar bacilli of daily bread-and-cheese! One perceives the dons and professors of the older learning rallying into a phalanx (formed according to the most accepted Roman rules) to withstand these Gothic onslaughts. What next? The evangel of the practical is being proclaimed with a vengeance, and the devotees of the antique are sadly disturbed. A professor of Greek used to lecture in a room beneath the one in which the professor of logic held forth eloquently. Applause was frequently heard from overhead. On one occasion the applause at the peroration was so vehement as to shake the building. "Gentlemen," said the professor of Greek, "the professor of logic's conclusions are likely to destroy the premises." It would almost seem that the spirit of modernity is sapping the foundations of what is known in academic circles as culture of the only breed.

Queer Curricula.

* * *

THIS disturbing movement comes from London, and from a School of Economics founded in connection with the London County Council; and the question arises of what ought to be done to reform the administration of education in the metropolis. Perhaps by the time these lines are read the world will know the momentous decision of his Majesty's Government anent a London Education Bill. At the time of writing, however, the contention between rival schemes for the Government's approval goes merrily on. The people who know most about the needs of the case—the elementary school teachers—are solid in their demand for a directly elected authority, existing for the purpose of educational administration, and for that alone. Others are crying out for the London County Council as the authority, and in that aspiration the bishops, strange to say, concur. It is not quite obvious why the ecclesiastical people in London should so favour the County Council, yet they do. But the Government and seven-eighths of the London M.P.'s are not likely to approve the London County Council for the purpose. To many of these the London County Council is—as a Malaprop said—"like a red bull to a rag." The third course suggested is that the London Educational Authority should be a kind of Water Board, made up by nomination from three sources:—

London Education.

(1) By the Crown;
(2) By the London Boroughs; and
(3) By the London County Council,

for the London County Council can hardly be kept out of the matter quite entirely. The fourth course fore-

shadowed is that the Technical Education Board should deal with education other than primary, and the School Board keep on, in its Cockertonised condition, for elementary education alone. The objection to this last course is obvious—it would mean two authorities instead of one. That objection is not likely to weigh with the Government so much as a certain difficulty attendant on this proposal—the difficulty being that by such a method the control of the School Board would have to be extended over the voluntary schools.

* * *

In the Provinces.

MEANTIME, under the Education Act of 1902, the Board of Education is being bombarded by eager County Councils and Town Councils, who, in the persons of their aldermen and clerks, gather in Whitehall, press up the dingy stairs of the halls of national learning, and enter the rooms of the parliamentary secretary and the acting secretary, waving rolls of paper on which are inscribed the outlines of administrative schemes. The avidity with which the new authorities are jumping at their new work is remarkable and embarrassing—embarrassing for the Board of Education, that is, because all, or nearly all, the new authorities want to begin their new work all together, at the earliest possible date; and there are but six hours in the Board of Education's day, and only five and a half days in the Board of Education's week; and the parliamentary and acting secretaries are new men, and the President of the Board is anything but a person accustomed to hard application or an expert. Excitement rages in the provinces also, where the question of whether or not representative teachers shall form part of the Education Committees is just now at a white heat. So far, a large number of schemes under the Act of 1902 provide for the presence of teachers on these committees; but in certain localities this idea is hotly disputed by the "elected persons." Something humorous occurred at Nottingham the other day, when the mayor, being the guest of the Head Teachers' Association at a conversazione held to welcome into the association the head teachers of voluntary schools, roundly told his hosts that they ought never to have asked for the inclusion of teachers in the Education Committee, and that it would be just as right and sensible to put a policeman on the Watch Committee as for teachers, being servants of the Education Committee, to sit upon it as well. There is, however, a probability that teachers will sit on these committees everywhere, in one or other sense of these words; and perhaps the simple sense of the words will be more comfortable for the committees than the slangy sense might prove to be. In any case, the Act of 1902 is already working swiftly, as a piece of lively leaven.

* * *

Euclid Dethroned.

IT used to be said that every great undertaking in England began and ended with a dinner. We are far on the way to change that, and soon shall have to put "conference" for "dinner." Conferences are in the air; they pervade every department of work; and if they are all as productive of good as the recent conferences on technical education, we shall be content to let the dinners go. One of the most fruitful discussions at the S. W. Polytechnic last month raged round the teaching of mathematics, and the opinions which were aired on the subject were advanced enough to make Euclid turn in his grave. Signs are not wanting, indeed, that the Euclidian fetish will soon be superseded; for even such strongholds of tradition as Oxford and Cambridge are giving up the time-honoured "Elements," though, it must be confessed, so far only in the lower examinations. Still it is a beginning, and the idol, if not overthrown, is being undermined.

The practical and experienced teacher will see with joy the formal study of definitions, axioms, and postulates superseded by the inventional and inductive study of geometry. Rules, compasses, the practical construction and discussion and dissection of geometric figures, will take the place of Potts's *Euclid's Elements*, and a livelier interest in geometry, and a more understanding appreciation of it, may be expected as the result. Besides, this treatment is much more in consonance with modern scientific method; it is bringing Euclid into relation with everyday processes and wants. This was a point enforced by Mr. Frank Castle, whose name needs no recommendation to readers of the *Practical Teacher*.

* * *

The Elusive Dot.

NATURALLY enough, these iconoclastic opinions on Euclid were followed by others equally severe on the necessity for the complete decimalisation of our system of calculation. The concrete study of geometry is closely linked with a thorough knowledge of the decimal system; and this, of course, brings in again, with even more force than usual, the necessity of introducing the metric system into this country. When that has been done, we can hope that there will be no reincarnation of the Chancellor of the Exchequer who asked, "What was the meaning of those d—d dots?" in an estimate—meaning the decimal points—a story retold by one of the speakers at the conference. For even Chancellors of the Exchequer will in future have been familiar from early years with the elusive decimal point. Our teaching of mathematics has been as formal and traditional as our teaching of the classics, and it may be that the adoption of more scientific methods by elementary, secondary, and technical school teachers may account for the striking preponderance of their pupils in mathematical honours lists, as quoted by Mr. Castle. At any rate, his statement that seven out of the first twelve wranglers in the last Cambridge tripos came from grammar and board schools is startling. If this is due to the improved methods of teaching mathematics adopted in those schools, then when this fact is once brought home to teachers generally, the old, formal studies in mathematics are doomed—Euclid will be finally deposed. Conferences are at times stimulative; none more so than those which have been inaugurated by the Technical Education Board of the London County Council.

* * *

Education by Machinery.

A STRIKINGLY new departure is discussed by Dr. Caze in the *Revue* of last month—a departure which we can only dub "education by machinery." Of course, the experimental field is America—that field of all experiments from politics downwards. Henceforth, according to Dr. Caze, American schools are to be provided with a number of instruments by which the teacher will be able to measure the mental capacity of his pupils. Henceforth, "teaching will become an intellectual mechanism cunningly regulated and controlled by a series of manometers which will indicate the elastic force of the intelligence of each pupil." Therefore, you see, the instruction to be imparted will be regulated impartially according to the measurement by the manom-

BRITISH MUSEUM

cter of the dose of ideas each pupil is able to receive. It sounds very fine and learned, but is such an array of instruments a necessity? Suppose one of them should get out of order and indicate a larger receptivity than the pupil really possesses. We should then have over-pressure of a new kind, or at least due to a new cause. Instead of pleading examinations as an excuse for pressure of work, we shall expect to hear that "some one has been playing tricks with the manometer." We have all had to face dictation, spelling, and arithmetic; but the unlucky young American of the future will have to face the algometer, the palatograph, the labiograph, the glossograph, the goniometer, the myograph, the ergograph, and goodness knows how many more meters and graphs. Will the result be any better?

❧ ❧ ❧

THE Americans do nothing by halves, and if Mr. W. R. Bridgman of Lake Forest College is to be believed, they "go the whole hog" in the matter of games at colleges and universities in the States. Games as played by scholars and students in Anglo-Saxon countries are usually credited with a certain educative and moral influence. But as played in America they can have none. Hence Mr. Bridgman's tears. He denounces the interference of the heads of colleges in the games of students, especially at the time of intercollegiate contests. These "solemn tourneys," as he calls them, demand considerable sums of money, much advertisement (!), and a long and severe training, which is a loss for the body of the students, since it is expended only on the representatives of the colleges. The students lose all responsibility in connection with the games, which lose in their turn all educative value, and for this reason Mr. Bridgman cries out against official interference, which he calls "Paternalism." If we really are, as he declares, a race who set more store, as education, by our games than by any other school exercise, then he is quite justified in raising an outcry against any influence which minimises the training in fortitude, unselfishness, and honour usually ascribed to English games. But in that case we should have used a stronger term than paternalism.

Paternalism.

❧ ❧ ❧

IT is not often that teachers' associations range themselves on the side of any political party when a purely political issue is at stake. But the German Association, which met last year at Danzig, did not hesitate to range itself on the side of the party which is making strenuous efforts to Germanise Poland. The Association called for drastic measures against the Polish language, and sent up half a dozen resolutions to the central government on the subject. The measures taken by the Prussian Government to suppress Polish nationality have called forth severe criticism from time to time in the European press. But the German Association of teachers out-Heroded Herod! They desire all Polish to be forbidden in secondary and upper schools, and in any instruction given by the clergy in church. Where Poles and Germans meet in the primary school, they would have Polish equally condemned. They wish all Polish newspapers to contain a parallel German translation, and no letter with a Polish address to be accepted by the postal services of the interior. And last of all they, the teachers, called for the suppression of all assemblies where the German language is not used! These are draconian resolutions, and they do more credit to the imperialistic instincts of the German teachers than to their hearts. It is rare indeed to find teachers, through their organisations, assisting in the stamping out of individuality, whether of persons or peoples; and penalising a language is the first and greatest step towards the destruction of the national individuality of those who speak it.

The Little Peoples.

❧ ❧ ❧

THE *Revue Pédagogique* contains references of interest. Mr. Brereton's article on English composition in the December *Practical Teacher* comes in for an analysis and a sympathetic criticism; and the readers of the same journal are recommended to study the "Lesson on the Study of a Picture," which appeared also in the December number. These efforts at bringing æsthetics within the range of the primary school are evidently appreciated by our contemporary. Apart from this, the month's English periodicals are dismissed with the remark, "The English papers are almost entirely filled with discussions on the *Education Bill*." Truly the heart knoweth its own bitterness! Months of heated discussion, volumes of speeches, deputations, meetings, threats, crusades, and jubilations, all are dismissed or summarised in that one brief sentence. It is the old fable of the mountain in travail over again; for if all the impression produced across the Channel by our feverish agitation can be summed up in that one line, it is truly a *ridiculus mus*. But the *Revue* promises to attend to the Bill speedily for the benefit of its readers. We, too, shall await that pronouncement with interest.

Ourselves and Others.

❧ ❧ ❧

A CURIOUS and interesting study of the Breton schools appeared some time ago in the *Temps*, in which one of the customs noted is so quaint as to merit description. Boys from the outlying farms and districts often stay with the schoolmaster as boarders, supplying their own food and bedding. The food, which is brought weekly by the parents, consists of a square piece of bacon, a pot of salt butter, country cakes, ten kilos of bread, and a little cider or wine. The bacon is hung up to a beam in the kitchen, with a tin ticket bearing a number stuck in it to distinguish it. Now comes the quaint part. Morning and evening each boy cuts off a slice of bacon, which he hands to the schoolmaster's wife or the cook for the common soup, after having stuck into it another little tin label. The slices are all boiled together, and when the meal is ready and the soup dispensed, each boy readily discovers his own slice by the tin ticket attached! "Nothing more curious," says the writer, "than to assist at the distribution of the slices of bacon, to which hang, like little bells, round pieces of tin." This description, be it remembered, does not apply to schools *des jours d'antan*—of long ago—but to schools actually existing. The boarding fee is not large. In the primary schools it is usually five francs a month, the boarder supplying, as said before, bedding and food. There is nothing luxurious about the life of a Breton boy, though there is much that is quaint to English eyes.

Breton Schools.

❧ ❧ ❧

EXAMINATIONS in general knowledge, so-called, are not so much the rule as they used to be, but the sight of a new volume of papers prepared for use in schools has set going reminiscences of old experiences. A general knowledge paper is one in which you find opportunities for heterogeneous guessing, seeing that the questions range

Very General Knowledge.

IRREGULAR PAGINATION.

over the whole universe of thought. A question on acetylene gas will be sandwiched between one on Boadicea and another on the Monroe Doctrine. Small wonder that the paper has always added to the hilarity of schoolmasters. At a well-known school in the north of England this "guessing game" was indulged in at the end of every term, with occasionally startling results. Complete the following quotation, "*Le roi est mort*," ran one question. And a boy promptly completed it—"*Vive la république!*" On another occasion, to the question, "Who was John Wesley?" a boy answered, "John Wesley invented Methodist chapels, and afterwards became Duke of Wellington." These we vouch for; and if our memory serves us correctly, it was in just such a general paper that the question was asked, "What was the Lupercal?" which elicited the remark that "the Lupercal was the she-wolf which suckled Romeo and Juliet!" The new issue of prepared posers should find a large sale among those who wish to add to the gaiety of the world.

N.U.T. NOTES.

"B. and O." Council.

IN addition to choosing the Vice-President and the Executive, members of the Union subscribing to its charitable funds—and certainly every one *ought* so to do—will shortly be required to elect the Central Council for the ensuing year. On this occasion, members will be chosen according to the districts in which they live and work. These districts coincide with the N.U.T. electoral districts, and, in the case of the provincial areas, return one member each. The three metropolitan divisions each return four members. And there is undoubted wisdom in the arrangement; for the Council meetings being held almost invariably in London, the expenses of such meetings are minimised by the majority of the elected members coming from the vicinity of Bolton House. Subjoined are the nominations from the various districts:—

District.	Ladies and Gentlemen Nominated.
1. North England ..	*Mr. P. Murray.
2. Lancashire	*Mr. J. Mennie.
3. Yorkshire	*Mr. T. G. West.
4. North Midlands..	*Miss A. G. Selvage, *Miss A. N. Stone.
5. South Midlands..	*Miss S. Dix.
6. East Anglia	*Mr. J. Baldwin, *Miss A. L. Broome, Mr. W. E. H. Wilson.
7. South England ...	*Mr. H. Hone, Mr. J. L. Mitchell.
8. West England....	*Mr. F. F. Wheeler.
9. Wales	*Mr. P. Thomas.
10. North London....	Messrs. *W. R. Hamblett, *J. Hodge, *A. Tutt.
11. East London	*Mr. J. Brown, *Mr. T. R. Rand, *Mr. E. Stollery, *Mrs. K. Truelove, *Mr. H. Weston.
12. South London.....	*Miss E. Ansell, *Mr. W. Brenchley, *Mrs. E. M. Burgwin, Mr. R. J. P. Campbell, Mrs. E. Chase, *Mr. C. J. Chase, *Mr. R. Greenwood, *Mr. E. G. Hardy.

* Present Members of the Council.

It will be observed that there are no contests in North England, Lancashire, Yorkshire, South Midlands, West England, Wales, and North London (where only three candidates are nominated for four seats). The sternest fights will be in East and South London, where members of the present council are unusually "thick on the ground." The pity of it is that *at least three* of the excellent ladies and gentlemen who have striven so hard for the funds during this "record" year must inevitably lose their seats.

A Bristol Dinner.

ON the last Friday in January an altogether brilliant company foregathered at the Royal Hotel, College Green, Bristol, to do honour to the President-elect of the N.U.T., Mr. Harry Coward. The chair was taken (admirably, of course) by Professor C. Lloyd-Morgan, F.R.S., the distinguished Principal of the Bristol University College, and his presence certainly evinced what he himself termed "the solidarity of the teaching profession." Some folks might have preferred to see the local President in the chair; but Mr. T. F. Miller is a singularly modest man, with no particular desire to shine, and anxious only to serve the cause of education and his fellow-teachers. The presence of visitors from far and near bore eloquent testimony to the esteem and popularity of the incoming President. Mr. Blacker journeyed from Brighton, Mr. F. F. Wheeler from Cheltenham, Mr. W. J. Prosser and several others from Bath, Mr. A. Winfield from Backwell, Mr. Yoxall, M.P., and Sir George W. Kekewich, K.C.B., from London; whilst Mrs. Croft and myself were only too delighted to travel 150 miles to so agreeable a function. The musical programme was of excellent quality, the chief contributors being Mrs. B. Phillips and the Clifton Glee Singers (Messrs. Horsell, Gass, Churchill, and Irving). The toast-list was of portentous length, though, under Professor Lloyd-Morgan's skilful leadership, we got through it with a few minutes to spare. "Our Guest" was drunk with musical honours, and Mr. Harry Coward had a great reception on rising to respond. His speech was happy, yet strenuous withal. Probably "Sir George" was, after the guest, listened to with the greatest interest; and his manly and sympathetic words were just what we might have expected from the best secretary the Board of Education has yet known. I have a notion that Sir George will not be sorry when the 1st of April—the official date of his retirement—arrives; and then, well, to use words not by any means original, "We shall see what we shall see." I heartily congratulate Mr. and Mrs. Harry Coward and the members of their family on the success of the memorable festival. The general arrangements were complete and perfect, as is everything else the Bristol teachers undertake.

The Late J. J. Graves.

WITH infinite regret, teachers all over the country will have observed with what frightful rapidity the cold hand of death is thinning the ranks of the former Presidents of the Union. Four times since Easter last it has been my melancholy privilege to voice the sympathy and condolences of the Executive to the bereaved and sorrowing relatives of our former Presidents. (Four times, also, we have lamented the loss of a former Executive member.) Mr. T. N. Day (President, 1878), Mr. W. Gardner (President, 1877), Mr. H. J. Walker (President, 1890) have all gone before; and now the genial and homely first President, Mr. J. J. Graves (1870), has joined the ranks of the great majority. For over thirty years he sat on the Executive, without a break; and when he finally retired, three years ago, Conference voted him, with enthusiasm and acclamation, a sum of one hundred guineas and an illuminated farewell

address. Mr. Graves was one of the men at the helm when the position of Executive members was attended with countless difficulties, if not actual dangers. The fact that the Union is, to-day, honoured, respected, prosperous, and powerful, is perhaps the best testimony of the sure and solid foundations on which our magnificent edifice was reared. During the closing years of his term as Executive member failing health prevented his taking a leading and prominent share in Union matters. But on the rare occasions when he *did* speak, we could always rely on something thoughtful, original, and quite *àpropos*. *Cacoethes loquendi* he never suffered from, and his speeches were ever models to us younger men of what debating speeches should be. Only the exigencies of my new position prevented my attending his obsequies, and paying a last tribute of affection and respect to the deceased gentleman.

THREE and twenty years ago I was a student at York Training College. At that time, I am compelled to acknowledge that my *alma mater* was not quite in the front rank, so far as equipment and *personnel* of the staff were concerned. Within the past few years, however, a quiet revolution has been effected within the walls of the impressive and comparatively venerable pile. The new Principal has gathered round him a staff of energetic, highly-qualified men as tutors and lecturers. In addition, since his appointment in September 1898, enlargements and improvements have been effected, costing more than £12,000. During the present year a new wing has been opened, which provides bedroom accommodation for about thirty more students. It also contains two sets of rooms for masters, bathrooms, downstairs changing-room and shower-baths, a smoke-room and common-room for the students, gymnasium, and masters' common-room. In September 1901 a fine lecture theatre, physical laboratory, chemical laboratory, and workshop for manual training were added to the college, and properly fitted up with all necessary and up-to-date furniture, appliances, and apparatus. A fine model school has also been lately opened. Needless to say, this is thoroughly equipped and furnished after the best modern plans. The whole college, including the students' bedrooms, is lighted by electricity—a unique distinction, so far as my knowledge of English training colleges goes. It was a real pleasure to me to walk round and inspect this now first-class college when, a few days ago, at the invitation of the courteous and kindly Principal, I attended in order to give a short address to the one hundred and four students now in residence.

Ebor Redivivus.

A. C.

NOTES FROM THE NORTH.

DURING the past month there has been a very full discussion in press and speeches of what might be considered the essentials of the next Scottish Education Bill. Naturally, however, the speech that has received the most attention is that delivered at Glasgow by Lord Balfour of Burleigh, the Secretary for Scotland. He expressed the hope that the Government would be able to deal with the whole of education, and remedy its weak spots from top to bottom. With regard to the area of educational administration, he said: "I hope certainly that we shall be able to have one authority for all classes of education; but you must remember that if we do that, it will involve *a change of area in some respects for elementary education.* You cannot give—at least I think you cannot give—the powers in respect of secondary education to all the small areas which now return School Boards. Don't let me be misunderstood. There is both good and evil in small districts; there is both good and evil in large districts. There are advantages and disadvantages in both ways of dealing with the subject." So far Lord Balfour is in agreement with the Institute's platform of "suitably large areas," and to this extent we welcome his speech.

The New Scottish Bill.

IN speaking on this point, and to allay some misapprehensions, as he put it, he said: "I myself do not believe, so far as Scotland is concerned, in any system that has not its basis on direct popular election. In small areas you get more intimate local knowledge, in large areas you get less of local bias, but that larger areas than we have got as the educational unit at the present time are a necessity for secondary and higher education seems to me an axiom of truth. It therefore remains to be seen if we can, as I think we can, produce *a scheme which will get all education in the hands of popularly-elected bodies with a community of interests.* We must preserve popularly-elected management in some way or another for small areas as well; and if we are to start a new area, I certainly hope it will be one which is coterminous with existing local government areas, so as not to increase confusion."

An "Ad Hoc" Authority.

LORD BALFOUR expressed considerable surprise at finding the number of small School Boards so great. Of the 972 School Boards in Scotland, 649, or more than two-thirds of the whole number, have the minimum number of representatives—namely, five. The figures for the rest of the School Boards are equally interesting, I think. There are 259 School Boards with seven members, 55 with nine, 3 with eleven, 1 with thirteen, and 5 with fifteen. But while Lord Balfour seems in favour of a larger area, there is a danger in the fact that he leans to the Parish Council. Taking the elections of the School Boards of 1900 and the Parish Councils of 1901, he finds that 40 per cent. or rather more of the School Board members all over the country are also members of the Parish Councils. It is pretty generally believed in Scotland that the members of School Boards are more capable than are those on Parish Councils. A magnified School Board, even at the risk of confusion, is preferable to a Parish Council.

Small School Boards.

THE Committee of the Association of Teachers in Secondary Schools have drawn up a series of suggestions on the proposed Bill. With regard to the Local Authority, they propose—"That the Local Authority should be the County Council, or the Burgh Council in the case of the larger burghs; that these Councils should work through Education Committees, consisting of a certain number of their own members, together with co-opted members; or, as an alternative, that the Local Authority should be a School Board chosen by popular election, the areas in county districts being enlarged by a combination of parishes, or of parishes and small burghs." This body does not favour the Parish Council; but if we are able to form an opinion from very indefinite statements, it would appear as if there was in many Government quarters a desire to make the Parish Council the new educational authority. This would mean the abolition

Other Views.

of the *ad hoc* principle. One authority says:—"The Parish School Board must be abolished; and here it may be observed that there is a remarkable amount of opinion in favour of putting the local management of schools into the hands of the Parish Council." It is admitted, however, that there must be an education authority commanding a large area, and for many reasons the county is the area to be desired. The difficulties to be overcome in its adoption are not insurmountable.

THE Hon. T. H. Cochrane, M.P., Under-Secretary of the Home Department, and a member of the Commission on Physical Education, gave a speech in Glasgow on this subject. He is strongly of opinion that in many of the better-class elementary schools the lack of physical education produces no very harmful results. But that is not the case with the poorest schools, perhaps with the majority of scholars. In the large towns, the schools in the poorest localities were those which had fewest advantages as regards physical training and opportunities for recreation. It is, above all, for these schools that a more elastic curriculum appears to be absolutely essential, and that, at least during the earlier part of the school life, the physical and recreative part of education should bulk quite as largely as anything of the nature of book-work or brain-work, and should bear a proportion to the rest of school life quite different from that hitherto assigned to it. By this means he thinks the school would become a centre of attraction, that it would take a larger place in the life of the scholars, that it would leave a deeper impression and play a larger part in their moral and physical training.

Physical Education in Schools.

MR. COCHRANE is convinced that it would be of immense advantage if some proportion of the school places, involving such a ceaseless and costly addition in large towns, took the form of playground or gymnasium accommodation. He would have voluntary assistance in the institution of places of recreation, which would be the common meeting-ground of a group of schools. So far as physical training consists in systematic physical drill, he thinks it should be an integral part of the school curriculum. The proper organisation of school games should be aimed at. The organised school game he regarded as a characteristically British institution. If some responsible authority were to issue an official invitation to School Boards to appoint Games Committees, the response would be a ready one. This speech is an important one, as showing the lines on which it is more than likely the Commission on Physical Education will report. It is to be hoped that the plan adopted by the English Board of Education will not be followed. Teachers on this side of the Tweed are not in favour of such a scheme.

New School Places in form of Playground Accommodation.

A CASE of some importance has been decided by the Court of Session relative to the question of Physical Exercises in Schools. A girl was expelled on 23rd September from the public school at Hawksland, Lesmahagow, because of her refusal to take part along with the other children in the physical exercises taught in the school, which, under the authority of the Scottish Code, were made compulsory on all children who do not offer what the Board considered a satisfactory reason for exemption. The question was whether the School Board was entitled to impose upon the girl's attendance at the school the condition that she should participate in physical exercise. By five to two the judges decided that the father had failed to show any reasonable excuse why his child had not been receiving elementary education. The Board was not bound to admit a scholar whose refusal to take part in physical drill might cause the school to lose its grant on that subject. It is, however, interesting to note that one of the two judges in the minority was Lord Young, to whom was largely due the Education Act of 1872.

School Boards and Physical Exercises.

CIRCULAR 375 just issued gives the Department's latest views with regard to the issue of Commercial Certificates. It is proposed that the Commercial Certificate should mark the successful conclusion of a curriculum specially suited for lads who propose to enter on a business career. They do not consider it essential that the work for the Intermediate Certificate in all subjects should have been completed before the pupil enters on the special commercial course. The examination in a higher-grade subject may be deferred. The certificate is only to be given to schools which are in possession of a regularly organised commercial department. The Department does not contemplate insistence upon rigid uniformity of programme, and definite proposals for a commercial curriculum may be forthwith submitted to the Department.

Commercial Certificates.

THE Department is prepared to consider, on parallel lines, definite proposals for a Technical Curriculum and a corresponding Technical Certificate. My Lords refrain from suggesting any rigid or stereotyped course. The main subject of such a course would be the further study of science and mathematics, with such subjects as drawing with instruments, machine or building construction, and wood or iron work. Continued practice in English composition and in the reading of standard English authors will be regarded as a necessary accompaniment of every specialised course.

Technical Certificate.

THERE are at present two candidates in the field for the presidentship of the Institute. The Highlands are going to make a bold bid for the honour on this occasion, and have secured in Mr. Thomas Wallace, Inverness High School, a very worthy candidate for the "blue ribbon" of the profession. Aberdeen, on the other hand, has proposed Mr. J. Mackenzie, Holburn Street School. Mr. Mackenzie withdrew last year from the field. The contest thus resolves itself into one between Inverness and Aberdeen for the next congress. Next month I hope to give some notes of the careers of the two candidates. The election this year takes place in May. For the vice-presidentship only one nomination has been made—namely, Mr. Beattie, Oban High School. It is not likely that he will be opposed. His defeat last year was due to the fact that the class teachers desired to have that office. This year no class-teacher candidate will be nominated. The Institute is likely this month to formulate its opinion on the proposed New Bill for Scotland. A meeting for the discussion of the subject is to be held on the 28th of February.

E.I.S. Notes.

R. G.

THE COMING CONFERENCE OF THE N.U.T. AT BUXTON.

THE PRESIDENT-ELECT,

MR. HARRY COWARD, F.E.I.S.

IN scanning the honour-roll of the National Union of Teachers, the now lengthy list of those who have attained the presidential chair, it is interesting to note the special characteristics which have marked the occupants of that distinguished position. The President of the Union may not merely be regarded as the chairman of its colossal Conference, and the ruler of the weighty deliberations of its Executive Committee; he is, for the time being, the representative, in the truest and most direct sense, of the great body of English state teachers.

There have been crises in the history of the Union when the possession, in an eminent degree, of organising power has been the qualification which has led to the election of a President. Loyal service to some distinctive but important cause has, in more than one instance, placed a Union worker at the head of affairs. The diplomatic recognition of the claims of a pressing minority has been responsible for the establishment of a chief. Admiration for youthful enthusiasm and the attractiveness of a pushful policy on the one hand, respect for invaluable experience and the claims of a career of unobtrusive but influential work on the other, have been equally effectual in bringing to the front leaders who have done honour to those who sought to do honour to them.

MR. HARRY COWARD, F.E.I.S.

Simple as may be the task of accounting for the elections of the past, it is far from easy to foreshadow the line of conduct to be expected from a champion about to essay the ordeal of the Union chair. The truth is, that the teacher-electorate, that soundly-schooled body of critics, honestly appreciates individuality in character and ability in the man of its choice, and the perils of prophecy might far less aptly be illustrated than by an attempt to say what might be expected from him. One of the shrewdest of our Past Presidents, writing breezily on Mr. Coward's well-known powers of debate, and particularly the effectiveness of his interrogation, said, "I sometimes think Coward ought to have been a lawyer.....When he reaches the presidential chair, it will be interesting to see how he will treat the man who wants to ask a question." We shall see. Those who know Mr. Coward's career must certainly believe with the writer just quoted, that he has realised the inwardness of the definition of practical genius as an infinite capacity for taking pains, and will agree, too, that few men are less prone than he to leave things to chance.

Whatever triumphs of fortune Mr. Coward may have missed by avoiding the mazes of the law, it is certain that he has lost few of the successes open to those who choose the scholastic calling. His earliest steps as a teacher were far from being devoid of difficulty, for he passed his apprenticeship in the British School at Warminster, an old-world town in Wiltshire, and miles of lonely country lay between his hamlet home and the school building. An excellent position on the Queen's Scholarship list carried him to the famous college at Borough Road, where he won golden opinions during his years of training (1874, 1875). His first school was at Hambrook, a picturesque village five miles from Bristol, and there he remained until he was appointed by the Bristol Board to the head-mastership of Anglesea Place School, Clifton, in 1883. The success of his work during the eighteen years of his stay there is widely known. The *Practical Teacher* for March 1892 contains an interesting account of Mr. Coward as "A Well-known Teacher at Work." Two years ago he was promoted to Knowle School, one of the largest of the Board's establishments.

As a brilliant lecturer at the Pupil Teachers' Centre and at the Training Classes at University College, Bristol, Mr. Coward came decidedly to the front in the city of his adoption. A very considerable proportion of the certificated teachers now working in Bristol must have vivid recollections of the living interest with which he was always able to invest the subject he was so well qualified to handle—English Literature.

The writer, assured by the pleasant recollections of a professional comradeship extending over many years, knows how fully Mr. Coward recognises that the most powerful factor in successful school-keeping lies in surrounding the teachers with the conditions which do most to promote enthusiasm in method, and to permit freedom of action. Many readers of these lines must know that the earnestness, the brightness, the vigour, and the tact which mark the Vice-President's efforts on the educational platform are equally characteristic of his work at the teacher's craft. Excessive system, excessive control, excessive restriction, excessive requirement are never likely to enter into any area of school work over which Mr. Coward wields authority.

Mr. Coward has long been a member of the Union. He took an active share in the business of the Bristol Teachers' Association immediately on his arrival in the city. He took office as Treasurer in 1884, and held the post until he was elected Vice-President in 1889. As President in 1890 his qualities as a leader added to his reputation, even in a body whose member-roll contained such names as Walker, Macnamara, and Francombe. He again passed the Bristol chair in 1898. In the Board Teachers' Association he passed some years of probation as Secretary, was several times elected Chairman; and in the discharge of the duties of these less public but highly important offices he maintained the entire confidence of his fellow-teachers, and commanded the respect of the local authorities with whom he was from time to time brought into contact. As a representative of the Board teachers he obtained, soon after the establishment of the Bristol Day Training College, the place on the committee which he still occupies. He did valuable public work, too, as Secretary to the Bristol Education Council established by Archdeacon Wilson of Manchester, when head-master of Clifton College.

It must not be supposed that Mr. Coward's Union work has absorbed all his out-of-school energies. For many years he took an active part in the work of the political organisation

of one of the Bristol divisions, acting for some time as its Secretary, and for a longer period as a member of its Executive Committee. He possesses, too, a very considerable share of musical ability, and was for many seasons a member of a local orchestra—Mr. George Riseley's well-known Society of Instrumentalists. It is an open secret that he has penetrated the mysteries of Freemasonry—at least, some of them. Those who know Mr. Coward's strikingly versatile powers of conversation will not need to be informed that he has found time to read widely and judiciously other literature than that of the Blue-book school.

Mr. Coward went to the Executive of the National Union of Teachers in 1896, and was again elected under the old system, by which candidates appealed to the whole country, in 1897. In 1898, 1899, 1900, and 1901 he was returned by the West England District, heading the poll on each occasion of a contest. At Easter 1902 he enjoyed the enviable position of being declared Vice-President at a Union Conference held in his own city, by a poll which stands as a record in the history of Union elections.

In the early days of his work on the Executive, he identified himself with the superannuation movement. He was for some years the Vice-Chairman of the Superannuation Committee, and he did much in that capacity to secure the recognition by the Government of the principles embodied in the scheme now in force. A large share of the delicate work of the Tenure Committee, too, has been entrusted to him; and during the year preceding his election to his present position he held the highly important office of Chairman of the Law Committee.

On many occasions his fellow-members have marked their appreciation of Mr. Coward's services by appointing him to represent the Union at such functions as the Congress of the Educational Institute of Scotland, the educational conferences at Brussels, Leyden, etc. At the Glasgow Congress of 1902, the teachers of Scotland conferred upon him the dignity of a Fellowship of their Institute; and the bestowal of this, the highest honour our brethren across the border have it in their power to offer to a Southron colleague, is a compliment which Mr. Coward is eminently qualified to appreciate to the full.

It is difficult to do justice within the limits of this paper to Mr. Coward's splendid efforts on behalf of the Teachers' Benevolent Funds. During the most stressful year in the history of the Council, Mr. Coward was its chairman, and the conspicuous skill displayed by him during that trying period proved the means of securing the interest of some of his most resolute and loyal supporters. These pages have time and again contained interesting references to the annual dinner in aid of the funds, which is now firmly established as a public function in the western city. For several years past the net result of this meeting has exceeded one hundred pounds. Mr. Coward has always been one of the most enthusiastic organisers of the Bristol dinner, and even amid the press of the duties of his important office he found time to act as honorary secretary in October last.

At the end of January in the present year, the Vice-President's Bristol colleagues evidenced their appreciation of his services to education by entertaining him at a complimentary dinner at the Royal Hotel, College Green, the scene of his efforts for the charities. An enthusiastic company of a hundred and twenty guests included Mr. Coward's predecessor in office, Mr. Allen Croft, who was accompanied by Mrs. Croft, Sir George Kekewich, Mr. J. H. Yoxall, M.P., Mr. Blacker, ex-President of the Union, and other fellow-members of the Executive, several members of the city Council and other influential citizens, the chairmen and other members of present and past School Boards, the local inspectors, and many fellow-teachers from the city and other districts far and near.

Characteristic of the many expressions of appreciation said and written are the following extracts from letters sent to the meeting:—

One of his Majesty's Inspectors wrote: "I need scarcely tell you how much I regret to lose this opportunity of showing my regard for one who has done so great a service to education in Bristol."

A leading citizen regretted he must miss "the opportunity of meeting him, and congratulating him on the well-deserved distinction he had attained."

A fellow-member of the N.U.T. Executive wrote: "A true friend and wise counsellor, with a clear judgment and a well-balanced mind. Bristol teachers in honouring him honour themselves."

A fellow-teacher, for many years a worker in close neighbourship with Mr. Coward, himself a prominent unionist whose efforts of pen and voice are widely known, wrote: "I have had many opportunities of admiring the high standard of professional honour and of fraternal helpfulness which have marked Mr. Coward.....His has not been a mere paper profession of one of the objects for which teachers are banded together, but he has shown, over and over again, that in him the great cause of education, the children, and the teachers have an able and a true friend."

A distinguished guest at the dinner who possesses unassailable claim to speak authoritatively of Union needs and Union leaders, most aptly and eloquently bore testimony to the wisdom of choice which has placed Mr. Coward at the head of affairs.

"Mr. Coward," said he, "comes to the chair of the Union at a critical period, a period of new departure; he will rule during an epoch-marking time, a time of creative influence. Genial, forcible, unconventional, original, courageous, a leader of tried ability, he must, as President of the National Union of Teachers, undoubtedly be successful."

In tendering Mr. Coward, as he nears the crowning-point of his fine career, the heartiest possible expression of goodwill, it may confidently be said that no sentiment could be more acceptable to him than the wish that his year of office may be one long remembered as a period of prosperity in all that concerns the cause he has served so manfully—the cause of national education.

CANDIDATES FOR THE VICE-PRESIDENCY.

ERE the publication of another issue of the *Practical Teacher*, members of the National Union of Teachers will receive voting papers containing the names of the many ladies and gentlemen nominated for seats on the Union's parliament. On the same sheet are also printed the names of the gentlemen seeking the "blue ribbon" of the Union; and it says much for the undoubted and unchallenged claims of Messrs. Jones and Sharples, that this year they have the fight all to themselves. Not since 1897 (the year which saw the redoubtable Richard Waddington victorious) has the number of candidates been limited to *two* only. Last year, as our readers may probably remember, four gentlemen entered the lists, with this result:—

Coward, Harry (Bristol)	16,109	votes.
Sharples, George (Manchester)	6,772	„
Jones, Thomas H. (London)	5,758	„
Muscott, William (Oxford)	1,962	„

Mr. Muscott, having actually polled fewer votes in 1902 than the previous year, has apparently realised the significance of the incident, and retired—at all events, for the present. The continuous increase in Union membership, satisfactory and gratifying though it be, year by year entails a greater expenditure on the part of the candidates for the Vice-Presidency, and their election committees. When one recollects that the constituency numbers close on 50,000 members, and stretches from Berwick-on-Tweed to Penzance, from Lowestoft to St. David's, one realises something of the difficulties which beset the candidates. The expense of reaching the various members of the Union individually is now so colossal, that probably in the future none will attempt it. Despite the smallness of the "field," this year's contest is not without interest. A short sketch of each candidate is subjoined, in the very earnest hope that all readers of the *Practical Teacher* qualified to vote will promptly do so, and return their papers to Russell Square.

MR. T. H. JONES,

the talented and esteemed head-master of the Burghley Road Higher Grade School, goes to the vice-presidency poll

for the second time, although he was nominated for the high office by many associations in 1901. In that year, however, it will be remembered how, with noble self-abnegation, he withdrew from the contest in favour of Mr. Allen Croft,

MR. T. H. JONES.

believing it to be for the absolute benefit of the Union that its honours should be distributed as widely as possible, and also that the public estimation of the class teachers would be advanced were one of their number elected to the Union's presidency. For many reasons the well-known supporters of Mr. T. H. Jones urge his claims upon the attention of the electorate. Here are three of them:—1. He is the senior member of the Executive seeking vice-presidential honours. 2. He has rendered magnificent service on the Tenure Committee. 3. His record is unbeaten. Dealing with the last point first, let us quote some striking figures which evince clearly enough the assiduity with which Mr. Jones has attended to his duties at Russell Square: 230 times present at Executive sessions out of a possible 234; 505 committee attendances out of 534 meetings! Probably these figures have never in the history of the Union been equalled, much less surpassed. His work on the Tenure Committee, whose chairmanship he has held since its foundation, has evoked not only the enthusiastic plaudits of his Executive colleagues, but the grateful remembrances of distressed teachers in the thirty-seven counties in which he has undertaken personal investigations. In this connection, we should like to recall a sentence from our interview of August 1900, when Mr. Jones was in charge of Duncombe Road Higher Grade Board School: "On more than one occasion Mr. Jones has left school on Friday for the station, travelled all night, spent the whole of Saturday in investigating, and caught the train back to London on the Saturday night, arriving home in the early hours of Sunday morning, never having had his clothes off since the previous Thursday." There is no need to strengthen the picture, surely! This year Mr. Jones has been nominated by some 120 associations, including Bath, Bromley, Burton-on-Trent, Cambridge, Cardiff, Chelsea, Dover, Dudley, East Lambeth, Finsbury, Gloucester, Greenwich, Hackney, Hastings, Ipswich, Llanelly, East London, West London Suburban, Luton, Merthyr, Newport (Mon.), Norwich, Reading, Rhondda, St. Albans, St. Pancras, Sheffield, Southampton, Southwark, Swansea, Tottenham, Walsall, Wimbledon, and Woolwich. His latest distinction is to become the President of the Association of Head Teachers of London Board Higher Grade Schools. "Whenever the Union requires, as its chief Executive officer, a man with a clear grip of the education question, one ever willing to sacrifice personal ambition, comfort, and ease for his fellow-teachers, or one whose constant and unceasing sense of responsibility is rarely equalled, and can never be excelled, it need look no farther than Mr. T. H. Jones, a strenuous defender of teachers' privileges." Thus we wrote a year ago, and the past twelve months have but strengthened our appreciation of the subject of our sketch.

MR. GEORGE SHARPLES,

last year's "runner-up" to Mr. Coward, has been nominated by 177 associations, comprising nearly 22,000 Unionists. These associations include Barrow-in-Furness, Blackburn, Birkenhead, Birmingham, Blackpool, Bolton, Bradford, Brighton, Bristol, Burnley, Carlisle, Chester, Coventry, Derby, East Derbyshire, Exeter, Great Yarmouth, Grimsby, Halifax, Huddersfield, Hull, Kettering, Leeds, Leicester, Leyton, Lincoln, Liverpool, Manchester, Northampton, Oldham, Plymouth, Portsmouth, Rochdale, Runcorn, Salford, North Staffs, Sunderland, Teign and Dart, West Ham, West Lambeth, Westminster, Wigan, Worcester, and York—a truly formidable list; and if he can poll even the majority of their members, Mr. Sharples will be proclaimed, ay, and acclaimed, Vice-President on Easter Monday next. For the past fourteen years he has been head-master of the Waterloo Road Board Schools, Manchester, where he has won golden opinions from both teachers and taught. Anterior to 1889 he had held the following professional appointments:—1. Head-master, All Saints' Church Schools, Bolton, 1876–9. 2. Head-master, Pikes Lane Board School, Bolton, 1879–81. 3. Inspector of Bolton Board Schools, 1881–3. 4. Head-master, Spring Grove Central Schools, Huddersfield, 1883–8. 5. Head-master, Leeds Central Higher Grade Boys, 1888–9—a record sufficiently varied to enable him to claim to speak with authority on the work and curricula of every grade of school. In his younger days Mr. Sharples was a magnificent football player, the captain of the famous Bolton Wanderers Football Club, and a county player to boot. His interest in athletics and sport is as keen to-day as heretofore; and perhaps only the lovers of cricket and football, cycling and golf, are *quite* capable of understanding what Mr. Sharples has sacrificed in serving his fellow-teachers. At Russell Square he is naturally a force. For the past two years he has served as Chairman of the Executive's Education Committee by common consent, the most important of all the standing committees dealing with the many sides of the Union's work. He had no light task when unanimously chosen to don the mantle of the veteran educationist, Robert Wild; yet he has thoroughly fulfilled the anticipations of his colleagues, high

MR. GEORGE SHARPLES.

though those anticipations undoubtedly were. When the Executive were asked by the Government to appoint a representative on the Teachers' Registration Council, Mr. Sharples was "the man of the hour." We divulge no secret when we state that in spite of obstacles and difficulties well-nigh insuperable, Mr. Sharples is, on that Council, steadily winning adherents to the Union's platform. Probably his most congenial work is his labour on behalf of the N.U.T. charities. It must never be forgotten that he acted as Sec-

retary of the B. and O. Conference Effort in 1895, and the cheers which greeted the magnificent £4,600 from Manchester and Salford alone, still ring in our ears. As a member of the Central B. and O. Council for seven years, he has given abundant testimony of a large heart as well as a sound head. An exhaustive list of the many distinctions conferred on him would fill too much space. We content ourselves with saying that practically every honour save the Union's blue ribbon has already been his. The conclusion of our character-sketch of him a year ago is perhaps a feeble indication of what thousands of Unionists have in their minds: "With personal qualities that inspire, straight away, both confidence and affectionate regard; with a style of public speaking as forcible and convincing as it is pleasant to listen to; with the ineffable privilege of having seen two of his former colleagues (in the potent personalities of Dr. Macnamara, M.P., and Mr. Waddington) show him the way to the Union's chair, we say with every confidence that a similar honour cannot from him be much longer withheld, and that when it *is* given, *the man* will not be found wanting."

STAGES IN GROWTH AND IN EDUCATION.

BY J. GUNN, M.A., D.SC.

A NEW definition of Education was recently given by Sir James Crichton-Browne at a conference of the British Child-Study Association in London, or rather it may be said that he gave memorable expression to that conception of it which all child students have somewhere at the back of their minds. Education, he said, is the guidance of Growth.

"Education is the guidance of Growth." Could we have this sentence accepted as the text of every Education Code, could we get departmental officials to take it as the text of their circulars which fly thick as leaves in Vallombrosa, we should not have borne in vain the obloquy of being called child students. Could we inscribe it in letters of gold—or of chalk—on our desks, it would be, to change the metaphor, a beacon whose warnings would save many a bark from the shallow waters of tradition, if not from entire shipwreck. Could we inscribe it on our own memories, which is perhaps the best place for the inscription after all, we should have such an ideal of our work constantly before us as would make nine-tenths of our educational handbooks superfluous, and might show us grave defects in the other tenth.

For surely education *is* the guidance of growth. If not, what on earth is it? And yet to look at education in this light is to see at once that unless we know something about growth, we are very foolish in trying to guide it. But to grant this position would be to admit that child study is the most necessary study of all for the teacher, and this is what many teachers would be very slow to grant.

Growth in animal or in plant is, up to maturity, a continuous process. It is continuous, but it is by no means uniform. At one time one organ or function seems to absorb Nature's care, while the others wait their turn. Then the character or the direction of growth changes; another part has its turn at Nature's hands, and so on. If we look at such a humble example as a common turnip, we shall see—I speak subject to correction by botanists and "nature-knowledge" specialists, but the illustration may serve—we shall see first of all a rootlet starting the running. Then a pair of seed-leaves take the lead. Next, foliage leaves develop, and the plant is content to produce little else for the rest of the summer. Now the growth of these becomes slower, and the tap-root develops. All this time there is no word of a flowering stem; or if there is, the gardener will see that the plant is precocious, and will therefore be of little use in the long run. Next spring the plant is ready to go on with the flower stem, and there is less of the foliage leaf to be seen. At last the flower develops, and then the seed may safely be attended to.

The point here to notice is that each stage in the growth has an important bearing on the final result. The perfection of the mature plant depends on the perfection of each stage of the immature plant. To force on a later stage before the time when it is naturally due, would interfere with the stage which should then be taking up all the available energy, and the result would be to mar that final perfection which is Nature's aim.

If we educated turnips in certain infant schools for vegetables, we should probably try to develop pretty little flowers during the first three months, in the hope that these flowers would be particularly fine by-and-by—much finer than those that had taken fifteen months or more to begin to appear. We should only spoil the plants by such efforts.

In certain respects, if one may say so without offence, we are all very like turnips. We also, when young, keep on growing, and we also grow by more or less definite stages—now one part of our nature and now another taking up the running. And the part which is "in season" is the part which should receive the teacher's care. Only in this way can the teacher work on Nature's plan, and it is only on Nature's plan that any real work in education can be done.

On the physical side, one kind of exercise is good at one time, another at another time, the times being determined by Nature, and not by school laws. Our interests run through a wide gamut, from sucking our thumbs or our toes, through the worship of dolls or of white mice, on to politics and the sum of human happiness, each at its own season in our life. Our instincts, too, flourish each in its own season and no other, all of them needed to build up the complete man, all of them capable of guidance or of starvation or of perversion. Our habits of thought vary from the simple "Oh!" to "Why?" and onwards through many stages to the differential calculus or the logic of Hegel.

In every aspect we change, but not by uniform gradients. At some times development seems rapid; at other times Nature prefers to go slow, or even *réculer pour mieux sauter*—to turn back for a run before taking a big jump.

In America, at the present time, great attention is being given to the study of "Nascent Periods" in growth—periods when a new direction is taken or a new phase is entered upon—in order that educators may be prepared to give just the kind of guidance that is required by the child at these stages. To give even a bald *resumé* of what seems to be already established regarding such periods would go far beyond the limits of such a paper as this. We must confine ourselves to a few of the more prominent facts regarding the child at the Infant School stage, in order to see how these may help in deciding what is the proper school work for him at that stage.

During the period under our notice there is one clear dividing point in the child's growth which is reached about the seventh or the eighth year. The sacred number seven has a certain significance in human life. The three most important nascent stages of youth fall, speaking generally, at the end of the first, the second, and the third septennium respectively. The character of the child seems to undergo a change about the age of seven or eight, and this natural change is the justification for transferring him from the Infant School to the Primary School at that age. We sometimes deplore the difference of methods which obtains between the Infant School and the Primary School, but there is in the child's own nature perhaps more justification for the difference than some of us have been aware of.

It seems to be established that about the seventh or eighth year—the period of second dentition—there is a pause, and even an apparent retrogression, in some phases of physical development. At that age a child may be more easily fatigued than at six, and perhaps even at nine his "staying power" will not be better than it was at seven. No doubt the exact age will vary somewhat with individual children, but a lesson for the school seems to lie in the fact of this natural pause; it is a time when laziness is normal, and when the energetic teacher is apt to run her head against a stone wall of Nature's own building. It is a time when pressure of work is likely to result in danger or in positive injury to the child; and yet until recently it was the time when every effort was made to pass the children out of the Infant School, marshalled in a straight line, under the banner of "Standard I."

In dealing with the period of the Infant School—the period of Childhood as distinct from that of Babyhood on the one hand, and that of Boyhood or of Girlhood on the other—it is difficult to decide which of its distinguishing features to select, there are so many. One can only choose a few, somewhat at haphazard, but with the purpose of illustrating how the growth stage of a period should determine the school curriculum of that period.

By the time our pupil comes to the Infant School he has made no little progress in life. His most marked advance is in physical growth. During his first year he did little apparently but grow. He reached a weight equal to about half what he will attain to at the end of his first septennium, when he leaves us for the Primary School, and he increased in stature at a rate which he will never again equal. And he has been growing since then, though with less alarming rapidity. He will continue to grow, too, while under our care; but he has now the teacher as well as the mother to reckon with, and the teacher's influence is not always conducive to natural and healthy growth.

If we are wise, we shall try not to hinder that growth which Nature aims at. We shall make it our business to keep a record of a few simple physical measurements which we make when he enters school, and once or twice a year thereafter. This will be somewhat of a safeguard to us and to him, and may be of vastly greater benefit than our record of the object-lessons which he receives at our hands. If we find anything abnormal in his physical growth, we shall have to inquire whether the cause is to be found in the school or in the home life; for if he misses the development which is his due at this period, we cannot go back again to make good the deficiency. As for our teaching, we can do something to make good any deficiency or interruption in that later on. So let us attend to the "compulsory subjects" first, and these are the proper lines of development of the physical frame.

A period of rapid growth is a period of great plasticity. The new material which is being added gives us the opportunity of moulding, and permanently moulding, the growing frame. Our pupil is now, therefore, at a stage when physical habits are easily formed. This deserves our attention. He may come to us with many very undesirable tricks of movement and gesture and attitude. These are more easy to alter now than later. At the same time there is a danger of our teaching him other tricks that are also undesirable, or at any rate of our giving him such work as will lead to tricks of this kind. If we place him in positions which he cannot maintain without fatigue, or allow him to stand too long in one position, or to sit on a bench with no support for the back or the feet, or let him work at a desk which is too low for him and requires him to stoop, or if we allow him to slouch as he walks, or to do any of those undesirable things which will occur to the teacher's mind in this connection, we are forming the pupil's body for him in a way which may hamper him all his life long.

As teachers, we look to the brain of our pupil with special interest. There, according to all the traditions of our profession, we find the field of our future triumphs or failures in education. We cannot weigh or measure the brain as a separate organ, but we can turn to the works of special observers to know what is the normal size of the brain at each year in children. The tale we are told may well make us thoughtful. By the end of his first year our pupil's brain had grown to nearly half its adult weight. Before he comes to us, more than three-fourths of its full weight has been attained; and by the time he leaves us for the Primary School, his brain will be practically full grown.

Now, if we think for a moment what such rapid growth implies, we shall see that nutrition is the primary need of the brain during the time he is under our charge. When a plant or an animal, or any special organ of one, is at a period of rapid natural growth, it seems obvious that any condition which entails unnecessary waste of tissue must be in direct conflict with Nature's work. We shall do well, therefore, to avoid in the Infant School anything of the character of "brain work." And the more ignorant we feel ourselves to be regarding the nature of brain tissue, and of the effect upon it of enforced study, the more wise shall we be in adopting the policy of "hands off!"

There are so many children who inherit tendencies to abnormal nervous conditions that we should be extremely careful to give our pupils the best chance of building up a healthy, well-nourished nervous system. We are apt to think of "nervousness" as something mental, but the brain and the nerves are as purely physical as the bones and the skin. Mental development, which is too exclusively the aim of our teaching, depends primarily on this physical development; and if we injure the latter in our striving after the former, we are, to use an expressive Americanism, "cutting away the branch on which we are sitting." Our traditional brain-work will come later; meantime the chief business of the brain is simply to grow.

The main function of the brain in all animals we may take to be the control and co-ordination of muscular movements. We have no doubt learned from our text-books of physiology that the action of the brain in thinking is practically the same as it is in performing muscular movements. Now no teacher can fail to be impressed with the fact that our Infant School pupil is specially strong in the department of muscular movement—he is *never* still. Thus Nature provides him with pretty nearly all the brain exercise he requires at this stage in directing the constant play of his muscles. It is accordingly through action that we shall be able to give his brain the best, because the most natural, training at this stage of his growth. And in acting on these lines we shall at the same time be doing the best for the training of his muscles, and indeed for the furtherance of his general health. But this is emphatically not the time for "brain-work" of the traditional kind.

We have said that in the Infant School period the brain reaches almost its full weight. This does not mean, however, that it reaches a state of maturity in its organisation. Its texture of inter-connecting fibres is still very incomplete. Its efficiency is by no means proportional to its size. Alongside of this, and causally connected with it, is the fact that our pupil's muscular control is by no means proportional to his muscular activity. He has fair command over the larger muscles of his arms, for example, but very little control over the smaller muscles of his hands and his fingers.

Nature here supplies us with a very clear indication of the kind of muscular work which is appropriate to the Infant School; it is work which provides plenty of activity, but demands little accuracy. This is the period of action for the sake of the action itself—that is, play; not of action for the sake of the result—that is, work. And when we try, as we must do in school, to transform some of this spontaneous play-energy into forms more directly educational, but still natural and pleasant, we must consult Nature again as to the kind of work to select. It must be work which does not demand any fine adjustment of muscular movements.

As examples of work to be avoided, we may mention writing with a pen, fine pattern-pricking, or laying small sticks in kindergarten work, needlework, and studying the forms of the letters in books, which last requires fine adjustment of the muscles of the eye. On the other hand, there are school exercises which are specially suited to this stage, such as drawing with chalk forms which are large (according to the pupil's scale of largeness), and which exercise the larger arm muscles without fatiguing the eye. Building with good-sized bricks and such adaptations of kindergarten work are also in place, and in general such exercises as lay no tax on the smaller muscles.

This may seem like neglecting accuracy of work, but it is merely a postponement of this until the proper time. Training in accuracy at this age is almost as useless as, and perhaps more injurious than, attempting to teach the art of walking to an infant before the age at which the control of the leg muscles is naturally acquired. We may secure precocious accuracy by dint of perseverance, but the time would be much better spent on work more in harmony with the pupil's development. A great deal of time is wasted in the race after precocity. We are prone to spend and to waste many hours in teaching a child to do at the age of six what he would learn a few years later with ease and pleasure; and this principle is followed out, not in the Infant School

alone, but also in the Primary, and perhaps in the Secondary School as well.

The children of inferior races are usually precocious as compared with those of civilised races, and among civilised races precocity is so often a sign of a mind wanting in balance and in staying power that we should avoid in school work any attempt to promote it. Our education should aim at guiding growth, and not at forcing on a maturity which must be unstable because not preceded by a normal period of youth.

Coming next to the mental activities of our pupil, we find that these have certain features which are also useful to us as indications of the kind of work suitable to his age. He is keenly alert in gathering up scraps of knowledge by eye and by hand. We mention the hand thus prominently because of the use which our pupil makes of it. He is never satisfied with merely looking at an object if it is within reach of his hand. Just as in earlier years he spent most of his time in trying to put things into his mouth, so now he yearns to lay hold of everything in which he feels the interest of curiosity.

These two senses are his means of self-instruction, and clearly they should be the means most employed by the teacher. The ear is of less importance as a world-explorer, but the tendency in school is to make it the most important of all the senses in giving instruction. In this matter we might do well to follow our pupil's teaching, and let eye and hand do their natural part in the exploration of the small world which he inhabits.

A striking feature of our pupil when he comes to us is his tendency to imitate others. He seems largely compounded of monkey and parrot—the former in his actions, the latter in his words. It is very largely through the strength of this instinct that we shall be able to lay hold of him and mould him as we wish; but we must face the fact that, through the same instinct, others, outside the school, will also lay hold of him and mould him very much contrary to our wishes.

The scope of imitation in school work lies more in the realm of conduct than of knowledge; and if we regard conduct rather than knowledge as the highest result of true education, we shall find the imitative instinct to be the most really educative feature of our pupil. In virtue of it, the teacher's own conduct becomes educative, apart from any formal teaching. Such characteristics as gentleness, earnestness, neatness and orderliness, politeness, and all the "minor morals" of daily life, are more commonly learned, if learned at all, by virtue of example than of precept.

Next to the power of the imitative instinct in general conduct and manner, we may consider its value in direct teaching. The acquisition of the mother tongue is a purely imitative process.* Since we receive our pupil at an age when this instinct is stronger than it will ever again be, we should use it to the best advantage for this end. Language is primarily a system of sounds; written language is merely an attempt to represent these sounds by means of arbitrary conventional symbols. So far, then, as language is concerned—and it forms a very large item in the school curriculum—Nature clearly teaches us that the work of the Infant School should be not reading and writing, but *hearing and speaking*.

It is matter of common observation that when a family has occasion to remove from one district to another where a different accent or a different dialect prevails, the young children—those of Infant School age—are the first to acquire the local accent or dialect, and they readily acquire then tricks of speech and expression which may persist throughout life. Older children who are situated in precisely the same circumstances, and who have the same opportunities of acquiring the local accent, are not so easily or so deeply affected. The style of speech which they acquired during their own Infant School period persists, because their imitative instincts are now weaker, and also, no doubt, because their vocal organs have already acquired a "set," and are thus less susceptible to change.

Children do not speak enough in our classes. In the playground they are sufficiently fluent, and they copy one another's errors of speech by frequent repetition. In the class the amount of speaking which falls to the share of each child is often very small indeed, and quite insufficient to form a correct style in the face of the incorrect style in which ninety-nine per cent. of their speaking is done.

There is no part of the formal training in the Infant School which can be compared in importance with this, so far as regards the saving of time in later years. Reading, spelling, writing, and the rest can wait, and will be not the worse but the better for waiting. Speech, both as regards words and sentences, must be formed now if it is ever to be well formed. Learned *as* it ought to be—by imitation, and *when* it ought to be—in the Infant School, it becomes a part of the child, and that without conscious thought on his part as to right usage. Left till later years, and learned by rules, it remains artificial and superficial, and this is a handicap on all educational progress. The pupil's *style* of speech demands part of his attention when all his thinking power ought to be devoted to the *matter*.

It now becomes evident that basing education on child-nature does not mean putting off everything but play till the child is about to leave the Infant School. In the case of language teaching, as we see, it means that we should begin much earlier than we are accustomed to do. In every case it means that we take our cue from the child's natural instincts, and make use of these as they develop, and thus, having wind and tide in our favour, make not only easy but sure progress.

We cannot now consider the kind or the amount of language exercise which the Infant School should provide. That is a question of method, and here we are dealing only with principles. But there can be no doubt that the solution of the vexed questions connected with pronunciation and composition, and all other problems regarding the teaching of the mother tongue, ought to find their solution during the imitative period of childhood.

We need hardly discuss the ethical features of this stage, for during most of the period we may say that the child has *no* moral character in the real meaning of the term. We recognise this in common speech. A *good* baby is one that takes his food properly and sleeps well; a *good* child is one that does what he is told at home and in school. The child himself looks at the matter in much the same way; a thing is wrong to him simply because it is forbidden. By-and-by, as imitation and suggestion become weaker, and as energy becomes more self-directed, he will act differently. Then perhaps a thing will be desirable simply because it is forbidden. And here we may see how the instincts of one period, if developed, help to give completeness to the next period. The child who has been moulded into orderly habits through suggestion and imitation in the earlier period will not require much compulsion to keep him in the way of well-doing during the later and more rebellious period. Reasoning and moral suasion mean time wasted absolutely in the earlier stage of childhood, and probably are of little use in the second stage. They are appropriate only to the age of reasoning and reflection.

While the child of five or six has no moral character, and is slowly forming moral habits by imitation, he has very distinct traits of feelings which tend to develop a moral bias. The only trait we shall notice here is his consistent self-centred egoism. It is not yet selfishness, because it is merely natural and instinctive, and not the result of a deliberate choice made between a lower and a higher ideal. He may also show beautiful and angelic moments of unselfishness, although on the whole this is foreign to the period; but these likewise are without any moral value, if we use the words in the proper sense. Sympathy, the child's first real lesson in ethical conduct, will come gradually, if not forced, by contact with other children, or, perhaps better still, with pet animals.

We must take account of this feature of early childhood in our instruction, as well as in dealing with conduct. The strongest interest to a child in all the objects which we show him or discuss with him is the personal interest, their relation to himself—not the real connection of one thing with another. We must to some extent, therefore, limit our teaching to suit his limited interests; otherwise we shall teach in vain. At the same time we should regard

this bias as a characteristic to be eventually superseded by other and wider interests. If this mark of childhood persists strongly in a later stage, it indicates arrested development—the root of all immoral conduct in adult life.

On account of this normal selfishness, as we may call it, of early childhood, games which require co-operation are not suited to the Infant School. The children do not take naturally to "team games," and when they attempt such games they usually end by quarrelling. Yet these games are of great value in evoking that sympathy and desire for justice which should displace egoism by-and-by. They must not, however, be forced upon the children with any view to fostering moral precocity, which is perhaps the most dangerous kind of precocity.

Coming now to the break between the period of Childhood and that of Boyhood or Girlhood, we know there are certain physiological changes which take place; but these could only be discussed aright by a specialist not merely in physiology, but in the treatment of children as well. The important fact for the teacher is that there *are* such changes, which stand in a close, and we may say a causal, relation to changes in mental power, instincts, and general character. It is these last which the teacher has directly to deal with.

When the pupil leaves the Infant School and enters the Primary School, his brain has ceased its most rapid growth in size, but is still maturing in ways which a brain specialist could describe. The brain has now established pretty full control over all the muscles of voluntary movement. The hand and the fingers can now be trained; and if they are not trained now, they will probably never become the perfect servants of the mind. Drawing and writing—brush-drawing first to develop surfaces, and lines later as the abstract limits of these surfaces, and writing later still as being a tracing of conventional symbols—these occupations are obviously suitable now. Hand-work of other kinds is required, so that full advantage may be taken of the new mobility of the muscles. This is the time for learning accurate movements and constructive work of many sorts. The future musician must have his hand "set" to his instrument at this period, or he will spend much weary effort on it later. The type of physical training at this stage is drill. Mechanical repetition is tolerable now, and is necessary to reach the fullest control of brain over muscle.

The second septennium is the period of strong verbal memory. It is probably because school life was formerly almost confined to this period that verbal memory has been made so much of, and has become a kind of fetish in school work. But verbal memory has its function in education, and this period, say from nine to fourteen, is its flourishing period. The time for great thoughts, æsthetic insight, or logical and scientific problems is not yet, though the buds of these may be beginning to appear. Now is the time for getting through the various forms of drudgery which school work must include, and which is not without elements of value for mental and moral training. Memory work is necessary in many branches. In the Infant School any severe work of this nature is impossible on account of the strain it implies. In the higher or Secondary School it often causes extreme disgust. In the Primary School it is less uncongenial and less dangerous than at any other time.

Play also changes its character when the physical boundary between Childhood and Boyhood is passed. Mere motion is not now enough; there must be a somewhat more remote end in view. In solitary play the end may be the making of things. But social play is much preferred. Games with definite rules can now be enjoyed, and as the years pass team games occupy the chief place in the boy's affection. The mimic warfare develops the need for co-operation and the love of justice. Fatigue is not now a danger, and accurate movement has become possible. The games may be begun which will form the chief exercise and amusement of the boy and the man as long as he can enjoy any game. Imitation and suggestion are weaker, but self-initiated activities are more strongly developed, and take the place of the activities adopted from without. The teacher is no longer the leader in play, but only the umpire and the judge.

Imagination has assumed a different phase. Thought does not now drift along as in waking reverie, one picture after another flitting across the screen in grotesque or haphazard sequence. Experience of the world has been growing, and the pictures of fancy come to be judged as possible or impossible. The fairy tale accordingly gives place to the story of the hero, in real life or in life that is presented as real. The "Boy's Story" is now in season. Tales of adventure and deeds of "derring-do" come like a breeze from the wide sea of life, which lies only just beyond the next bend of the river.

We need not trace further the changes which are of educational significance in the new period. Enough has been said to illustrate the main thesis, and to show that we have here a stage of growth which is different in kind from the former. Some instincts and tendencies have "had their day and ceased to be," whether we have made the best of them or not. Others have appeared in full strength, and these also have a function to perform ere they yield place to the instincts and tendencies of the adolescent or Secondary School period.

The conclusion of the whole matter is surely this—that we must know and observe the natural stages of growth, and adapt our school work and treatment to these stages. We can guide growth only by providing appropriate exercise for every natural power at the proper time, neglecting nothing, and forcing nothing into precocious maturity. The study of nascent periods is educationally one of the most interesting, and also one of the most directly useful, forms of child study.

NOTES AND JOTTINGS.

Some time ago we gave our readers an account of the Christmas letters sent by one of our "Well-known Teachers" to each of his scholars. We have received a copy of the one sent by the same teacher last Christmas, and feel sure that our readers will be pleased to see it:—

"My Dear Scholar,—Many changes take place in the course of a year—changes of home, of friends, of thought. But, come what change there may, one thing is left that changes not. The desire to wish friends well is always in the heart of the true. The desire grows at Christmas time, when love and blessing are bound most firmly together.

"'On earth peace, goodwill to men' is the way we tell the love and give the blessing.

"May *your* Christmas and *your* New Year be crowned with peace—the peace that makes the heart rejoice. May no cloud of sorrow, distress, or evil thought keep you from the sunshine of joy, mirth, good deed. May the hope that comes at early morn to show goodwill to all be full at evening time. May you think, and speak, and act true.—These are the wishes of

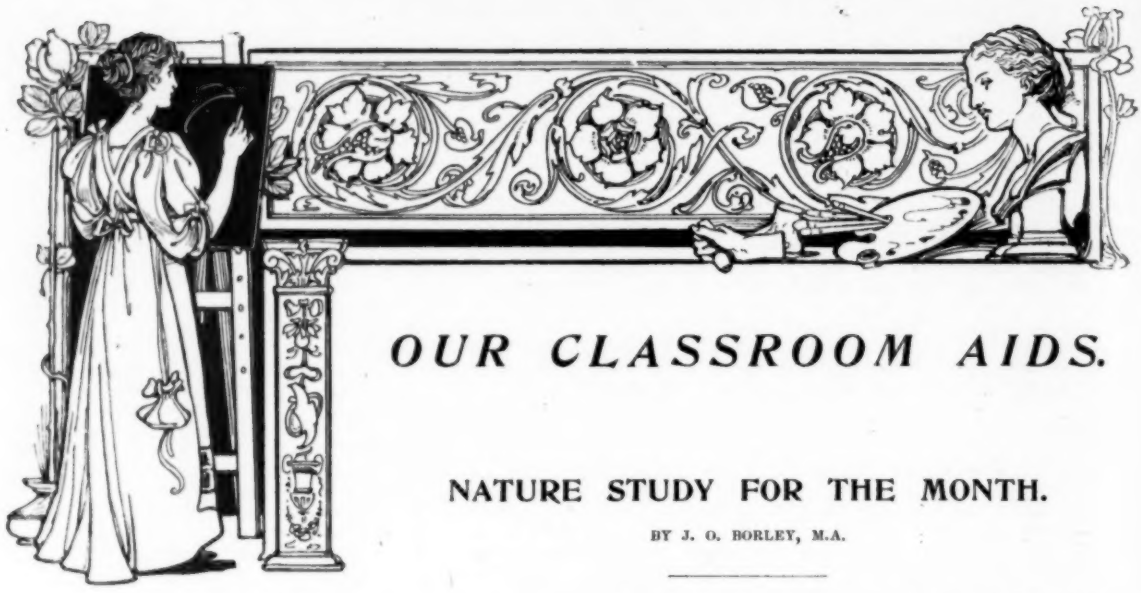
"Your affectionate Master and Friend.

"*Christmas Eve, 1902.*"

The Commissioner of the "Universal Exposition of St. Louis, 1904," has sent us an account of the plan upon which the awards will be made. It is proposed to compare the exhibits with some actual practical standard article, and not with an ideal that perhaps exists only in the minds of the jury. It has also been decided not to have a separate exhibit of women's work. Women will exhibit in the same classes as men, and their work will be judged by the same standard.

School Board Elections.—We cannot say whether there will be a School Board election in London when November comes, but the Board of Education has sent a circular to all other School Boards calling attention to the following rule in the Second Schedule of the Education Act, 1902: "No election of members of a School Board shall be held after the passing of this Act, and the term of office of members of any School Board holding office at the passing of this Act, or appointed to fill casual vacancies after that date, shall continue to the appointed day, and the Board of Education may make orders with respect to any matter which it appears to them necessary or expedient to deal with for the purpose of carrying this provision into effect, and any order so made shall operate as if enacted in this Act."

On the eve of going to press, we receive a copy of Mr. Yoxall's new novel, *Alain Tanger's Wife* (Hutchinson). Obviously we can do no more at this unpropitious moment than call attention to its publication, and promise an extended notice next month.



OUR CLASSROOM AIDS.

NATURE STUDY FOR THE MONTH.

BY J. O. BORLEY, M.A.

Rain.

THE main divisions of this subject are—the nature of rain, the cause of rain, the amount of rain, the effects of rain. Space forbids anything but an introduction to this subject; and as the last subject was almost entirely a matter of observation, it may be as well to keep this entirely practical. It would be natural to start with the departure of the drops from the clouds, the immediate cause of rain. Unfortunately so little is known of this as to make it impossible to do so.

Nature of Rain.—The exact composition varies. Roughly, however, all rain will differ from river or spring water (*a*) in the absence of dissolved solids; (*b*) in the amount of dirt present, rain being generally very dirty, especially in and near towns. Experiment:—Allow rain to collect in a white dish or pan. Notice the dirt. Filter through blotting-paper folded twice at right angles and fitted in funnel.

Rain, then, evidently differs from pure spring water, which is clear. The question how it loses its dirt presents itself. The earth is the only apparent filter through which it passes before issuing as a spring. It will be well to exhibit earth as a filter. A flower-pot will serve. Cork up the hole with a cork that is a little too small; then fill the pot with sand. Hang this over a white saucer, and pour muddy water in on the top of the sand: an appreciable amount passes through in a few minutes. If a glass funnel is used instead of a flower-pot, the stain of mud can be seen extending down the sides and gradually ceasing. A cork or small inverted thimble put in the funnel before filling with sand prevents the latter from running through; and fine ash—from a fire, for instance—is more suitable than mould to use in making the water muddy.

Obviously only porous earth can thus act as a filter. It will be as well, therefore, to exhibit specimens of such rocks as sandstone and chalk, and some non-porous ones (clay, for example), and show their power of absorbing water; and a class which has no knowledge of springs might conveniently receive a lesson on the subject in connection with this matter.

The further question arises, Does the water take anything from the earth as it filters through? What would happen, for instance, were it to meet with salt? Cases of salt springs furnish the answer. But to see whether the case is more widespread, let the children, unless in a district destitute of chalk, evaporate to dryness in clean, dry beakers or test tubes equal quantities of filtered rain water and tap or river water.

The tap or river water leaves a whitish stain on the glass, the rain water does not. A conjecture may then be made as to which of the porous rocks furnished the white solid, for evidently the rain gained it from the earth.

Chalk or limestone suggests itself. Very few children will be ignorant of the deposit occurring in kettles which have been long used, and this furnishes a larger supply of the solid. Some of this "crock" can be compared with chalk, with a view to testing our suggestion.

The completeness with which this can be done, and whether, indeed, any attempt at it can be made, depends naturally on the knowledge the class already possesses of the rudiments of the way in which such questions can be studied. The experiments following are for the most favoured; possibly for a great many some selection may be made.

In two test tubes put pieces of chalk and kettle "crock" respectively. Cover with water, and add an acid—say hydrochloric acid solution (spirit of salt), or, failing that, vinegar. If the latter is used, omit the water; but even then the action is extremely slow. Partly close the top of the tube with the thumb. After a time hold in the mouth of the tube a lighted match; it is extinguished. Allow the effervescence to go on for a little, and again close the mouth of the tube; then slowly incline the tube with its mouth over another half full of lime-water, until the contents of the tipped tube almost flow out. Close the lime-water tube and shake it up. It becomes milky. Do these experiments with the chalk and the "crock," and it will be seen that the same results are obtained; hence the conclusion that the "crock" is really chalk.

It may be objected that such experiments are sufficiently foreign to the ordinary life of a child who has done no science work as to be meaningless to him or her. It may be so; and yet the objectionable features may be reduced to a minimum, and the valuable part emphasised, by a little previous thought as to the course of the work.

Firstly, no one action must be given as a "test" for chalk, and no result prophesied: the experiments must be made with the two substances simultaneously, and the differences as well as the resemblance noted. Then (with much difficulty, personal experience suggests) some rudiment of the conclusion will be reached by the children, that, since these two substances act in the same way towards acid or vinegar, produce in each case a gas that has the same effect on a light and on lime-water, they must be, or contain, the same thing.

The brown or gray colour in the "crock" will show that other things besides chalk are present, and hence that other rocks have been acted on by the rain. It may not be superfluous to add that round chalk for blackboard use is generally calcium sulphate, and useless for the present purpose.

In places where the water is markedly hard, the following is useful. Boil up some soap cut into shavings in boiled water, producing a solution. Gum a label on a test tube;

fill to this height with rain water. Add the soap solution, drop by drop (shaking after each drop), till a permanent lather or froth remains. Count the drops necessary to produce this. Now use the same quantity of hard water, and repeat the experiment, again counting the drops of soap solution. Notice (*a*) the formation of a scum, and (*b*) the greater number of drops necessary to produce a lather; hence hard water wastes some soap in forming the scum. Repeat again, this time filling up to the label with *boiled* hard water. Note that most of (in some cases all) the hardness has disappeared. To secure equal size of drops use a glass rod; this, if dipped in the solution and withdrawn, will retain the drop upon it as long as it is held nearly horizontally. On inclining it, the drop falls.

The Amount of Rain.—It is suggested that some form of rain gauge should be made by the children; however rough and primitive, it will be useful both in its making and use. What is hoped for by the use of the gauge is some approach to a realisation of the amount of rain falling in a shower or during a given period; and further, that this, together with the actual fitting up of the gauge, may help to make the subject of rainfall in geography less a matter of print and memory. If some attempt is made at a record of the direction of the wind on wet days, so much the better. The wetness of a wind can then be seen to depend on its direction—that is, whether from sea or land.

The simplest form of rain gauge consists of (1) a funnel to catch the rain; (2) a vessel to collect the rain thus caught. An ordinary tin funnel does very well. It must be at least eight inches wide, and is most suitable when its mouth is surrounded by an upright rim, as is generally the case with wide tin funnels. The support can be an earthenware jar or a can wide enough to allow the hand to enter its mouth. Within the jar, and immediately below the funnel, a beaker or a tumbler should be placed (if either of these can be procured with upright ends and flat bottom; if not, a small tin can be used—for example, a mustard tin). The tip of the funnel should enter this can, and the sides rest on the earthenware jar.

The gauge should be put in the centre of a large field or playground—that is, unsheltered by houses; but, of course, sufficiently good results can be obtained for school purposes by having the gauge on a wall, or as little sheltered as possible. It must, however, have the same position always. The amount of rain should be measured each day.

The rainfall can be reckoned either comparatively or absolutely in inches; the latter is preferable. Thus, suppose a tin is used as a collector, graduate it by gumming a paper down the outside of the can, and mark it off in inches and parts of an inch. To estimate the amount collected, lower vertically into the collector a knitting-needle till the point just touches the surface of the rain water, while the thumb-nail touches that part of the needle at the top of the can. Keeping the thumb in position, raise the needle and lower again outside the can against the scale, and the point shows the depth of the water in the can. Compare the depths on different occasions; but better, reckon the rainfall in inches for the district. To do this, it is necessary to know the areas of the funnel and collector. If the class cannot find these from the diameters, procure some paper ruled in inch or half-inch squares—the smaller the squares the more accurate but tedious the operation becomes. Now, draw circles on this paper—one equal to the mouth of the funnel, and the other equal to the mouth of the collector. Count the squares included in these circles, and this gives the areas required.

Suppose the area of collecting can comes to three square inches, about, and depth of water is half an inch, then volume of water which fell on the funnel mouth was $(3 \times \frac{1}{2})$ cubic inches $= 1\frac{1}{2}$ cubic inches. Had this fallen on an area equal to the funnel's, and remained standing, it would, of course, have made a very thin layer. The area of an 8-inch funnel is about 50 square inches. Then it follows that the depth of this thin layer would have been $\frac{1\frac{1}{2}}{50}$ inches—that is to say, the rainfall for the day was $\frac{3}{100}$ of an inch. The figures given show that, by no more delicate measurement than that of half an inch, a very small amount of rainfall can be estimated, though roughly, of course. The smaller the area of collecting can, the deeper the minute amount of rainfall appears. Hence it will be advisable to use a very narrow can for a gauge to be used in a single lesson, and left out for a short time only; a broader one for a gauge to be left out all day.

Some surprise may be expressed at the small depth of fall during even an apparently heavy shower, when measured. Seldom as much as an inch of rain will come down in a single storm in England. It is not a bad exercise, after a shower, to get the class to calculate the amount of rain, and its weight, which fell on a given playground or field. It will prove to be far greater than the small depth of the rain would lead one to expect.

The *effects of rain* depend to a great extent on the district. Hilly districts show the wearing away of rocks and soil by rivers; coast districts show the deposition as alluvial land of the products of this action—the particles eroded or worn off. It would be difficult to deal with all these: such as are studied should be studied in the open air, and may best be spoken of in months that allow of this.

Wind.

As wind, air affects us in its most nearly tangible form. A good introduction to lessons on air is therefore formed by lessons on wind, especially if, in the latter, properties and actions are dealt with which are more a matter of daily experience than air pressure, expansibility on heating, and the other usual subjects. Some suggestions of a suitable character are therefore made.

Direction.—It will not be superfluous to let the lowest classes make model wind-vanes, and learn their action by blowing. An oblong card can be used, one end cut to a point, and a short glass or tin tube or a straw threaded in and out of cuts made in the card near the pointed end, under one another, and parallel to the long sides. A cross is then made of cardboard, a knitting-needle stuck upright in its centre, and the tube lowered on to it. The card will now be found to point to any person who blows at it; and if the ends of the cross are marked N, S, E, and W, the model is complete.

Having learned the use of a vane, note and study the character of different winds—W. or S.W. wind, wet in England; S. wind, warm; and so on. Try to account for each.

Drying Action of Wind.—Water evaporates far more quickly in a wind than in calm air. This may be shown by wetting two similar sheets of blotting-paper, hanging one in the middle of a room, the other over the crack of a partly-opened window, and noting the time each takes to dry. A far better way is to make a small instrument as follows:—Close a glass tube about a quarter of an inch across, by drawing it out near one end in a gas flame. The tube should be three or four inches long. Wind some wire round the tube a few times near its open end; then bend it out at right angles, back again under the tube, and then into a ring. Cut a piece of blotting-paper about two inches square; fill tube with water; push blotting-paper in between the wire ring and the tube, forming a flat cover. Invert tube, and when paper is thoroughly wet, hang up first in still air, then in the draught of a window. The fall of the surface of the water in the tube shows the amount of evaporation which has occurred, which will be much greater in the draught. Methylated spirit acts much more quickly than water.

This drying effect is due to the wind renewing the air over the wet surface; it is, therefore, more efficacious if the air brought to the surface is not already wet. This accounts both for the rapid drying by an east wind, and for the injurious effects that wind has on vegetation. It is not the chill, but the loss of moisture that kills the plants, since an equally cold wet wind is often harmless.

The Spring Equinox.

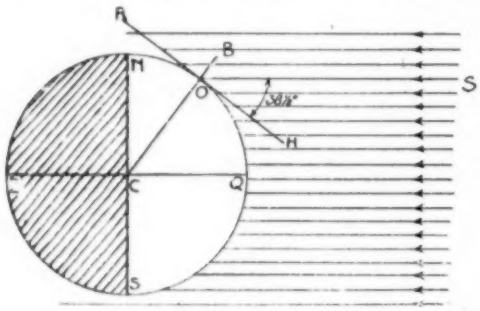
On 22nd March the spring equinox occurs. An observation of the sun's height above the horizon on that day at noon may be of use in studying the seasons.

To obtain the altitude at midday, either of the following methods can be used:—

1. On flat land, or on a table in the open air, erect a straight rod or long ruler. Test its uprightness by a plumb-line, and make sure the surface it stands on is at right angles to it. At noon note the position of the end of the shadow. Stretch string from the top of the stick to this point, and (if class is not used to measuring angles) place a card behind it with one edge resting on the flat surface. Mark along the string, take the card away, and cut along the line just made. The inclined edges of the card now make with each other the same angle as that made by the sun's rays with the ground. Instead of the rod used out of doors, some mark on a window with a south aspect can be used, the shadow, of course, appearing on the floor.

2. Fix a card upright against the edge of a table, pierce a small hole in it on a level with the surface of the table. At noon let one person look through the hole at the sun, while another moves a round piece of paper or card over the window till the sun is obscured from the first observer. Fix the card in this position, and stretch cotton from its centre to and through the hole at the table, and obtain the angle as before.

Now draw a diagram consisting of a circle representing



the earth, and mark the axis and equator. (Fig.) Put O, the position of the observer, fairly accurately as to latitude. Now OB is the direction of the perpendicular to the earth at O, hence HOR at right angles to OB is the horizontal plane. Place one edge of the "angle card" along HO, and draw OS along the other. Then OS is the direction of the sun's rays. Sunlight reaches us in parallel rays. Draw lines parallel to OS to represent it. On 22nd March it will be found that these lines graze the poles, and are perpendicular at the equator. Hence on that date no place has darkness or light for the whole twenty-four hours, and the other characteristics of the equinox can be deduced.

It will be well to perform this experiment a fortnight at least before and after the equinox, and similarly before, at, and after the summer solstice. The results will show the northward march of the sun, as well as the places at which the sun is vertical, does not set, or does not rise. The Fig. is constructed for the equinox at London.

NATURE-KNOWLEDGE.

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PLANT LIFE: POLLINATION.

THE following notes will be of service in country schools, or in city schools within easy reach of a winter-garden or large conservatory of some sort, and they will serve to bridge over the gap between flowers and fruit.

Take a large flower, say a tiger or orange lily; examine the ripe and unripe stamens in several flowers; call attention to the different appearances in colour and texture presented by ripe stamens; and remove with the finger some of the pollen. Now look at the pistils of some other lilies, and observe how sticky some are, showing that they are ready for pollen. Lightly touch a pistil with the pollen-smeared finger, in imitation of the passage of an insect, and observe how the pollen sticks to the pistil. Explain that in a natural state this is generally done by insects or the wind, but in the artificial conditions of a greenhouse the gardeners have to brush off pollen from one flower, and with it dust the pistils of another.

Examine some other common flowers—for example, wall-flower—to see different colours of pollen. Some pollen grains are dry and dusty, easily blown by the wind; others are gummy, and therefore sticky; while others are furnished with rough projections like the prickles of a burr, so that they cling to any insect visitor. It will be found that the last sorts occur in plants fertilised by insects, the dusty kinds in those fertilised by the wind.

Pollen is not easily killed. Wallflower pollen remains alive for a fortnight, pansy pollen for nearly a month; so that, if necessary, flowers at a distance could be fertilised through the post, an arrangement actually followed by gardeners for certain palms. The important point is to keep the pollen dry till the right time.

In this respect the great enemy of a ripe flower is rain, which washes the pollen away before it has done its work, and many devices are adopted by plants to dodge a shower. In the tropics, where all the year's rain falls in a short time—the rainy season—the flowers do not open till this season is over. On high hills, where daily rain may be expected in the summer, the flowers are often bell-shaped, and hang down so as to form a natural umbrella over the stamens within and beneath. The common lime tree has its flowers below the leaves for shelter, so that on looking down from above, or even from the side, not a flower is visible, while they are all exposed to the view of a person below the tree. Many flowers close their petals on the approach of rain, such as the rose, peony, water-lily, globe-flower, and many others; the common crocus often closes when the sky is merely cloudy. Many flowers protect themselves by bending their stalks on the approach of rain, so as to look downwards and form an umbrella. This list includes such common examples as the tulip, wood anemone, crowfoot, poppy, chickweed, bell-flower (*Campanula*), and herb-robert, so that these, with the others already mentioned, form a fair barometer. The balsam (*Impatiens noli-me-tangere*) is an interesting plant in many ways, and especially in this connection. When its flowers are in bud, they lie above the leaves; but whenever they ripen, and the pollen becomes valuable, they twist so as to lie below the leaves. The same plant generally shows all the stages. Even the daisy is a good example of protection. In wet weather the outer, white, strap-shaped flowers, which are barren, and serve chiefly as landing-stages for insects, curve over the central, yellow, tubular flowers, which contain the pollen; the green involucre also curves over them; and finally the stalk bends as well, and the whole flower hangs down.

The two great agencies in pollination are the wind and animals, especially insects. About one-tenth of our flowering plants are fertilised by means of wind, and they comprise such forms as the following, from which a selection is easily made: grasses, sedges, rushes, and reeds; the cereals, which are simply cultivated grasses; all lofty trees in woods or plantations among their own kind; lastly, nettles, plantains, hops, hemp, and all pond weeds in still or running water. Since there is no sentiment about wind, bribery by gratis honey and the attractions of colour and perfume would be wasted in this case, and so the flowers of all these plants are small, inconspicuous, often some shade of green, devoid of honey and perfume. Further, to meet the ascending swirls and currents which are the rule among surface winds, it will be found that in forest trees the passive female flowers are near the top of the tree, while the males which have pollen to shed are at the tips of the branches near the bottom. Further, since the presence of dense masses of foliage would interfere very seriously with the diffusion of pollen, it will be found that in nearly all cases of wind pollination the flowers appear before the leaves. Examples of this are seen in such well-known trees as the alder, ash, elm, hazel, willow, birch, aspen, etc. In these trees there is accumulative protection: first the flowers appear, and have the field all to themselves; then the young fruit, still green, tender, and ex-

posed to attack, is screened by the growing leaves, which have the same colour; as these turn russet the fruit darkens, hardening at the same time; finally, when the leaves fall, the fruit is weather-proof, and often, like the chestnut burr, stout enough to defy even animal attacks.

Pollination by animals constitutes a romantic chapter of flower life, which Grant Allen, in his *Story of the Plants*, describes as marriage customs. Insects and flowers are dovetailed in natural economics. When the flowers are opening in spring, the winged insects are also emerging from their winter cocoons; plants which open in the morning are visited by morning insects; evening flowers attract evening insects, such as moths, by displaying a strong heavy perfume and a white signboard, easily seen at dusk. The inducements offered to insects in exchange for free carriage of pollen may be grouped under three heads—1. Care of their young; 2. (seldom) refuge against storms; 3. (and most common) food, either in the form of pollen itself or of some special dainty, honey or nectar, in even greater demand. Roughly speaking, the more pollen the less honey. If a flower is rich in pollen, it can afford to part with some as food to an insect in exchange for the carriage of the rest; for a single grain of pollen is sufficient to fertilise an ovule. Examples of this are shown by the poppy, rose, clematis, and several anemones, where there are many stamens, plenty of pollen, and no honey. Honeyed plants are often poor in pollen, are provided with all manner of appliances to save their scanty store, have guide lines, often highly coloured, to lead honey-seeking insects to the nectaries along such a track as will best serve for pollen transport, and so on. These honey guides are very well seen in some of the larger lilies already mentioned, and the class should be shown that these lines lead past the anthers to the honey glands in such a way that an insect is bound to brush against the anthers, and so remove some pollen.

The colours of flowers play an important part in attracting insects, and the colours are always those which form a good contrast with the foliage and surroundings, as the following percentage shows: white, 33; yellow, 28; red, 20; blue, 9; violet, 8; brown, 2. It is the side next the flying insect which shows the colour, therefore in hanging flowers it is the calyx or the outside of the corolla. As an example of flower facing upwards, take the pimpernel or the lesser celandine, the latter of which has yellow or even white leaflets, green on the under and unseen surface. In many plants it is the sepals which hang out the sign: examples are the globe-flower, Christmas rose, wood anemone, marsh cinquefoil, and fuchsia. In willows the stamens become golden yellow and scented, and appear before the leaves; while in Labiatæ and Umbelliferæ it is the bracts which do the advertising. Wasps are attracted by brownish flowers which resemble decaying fruit. Dungstead insects go to the greenish-yellow flowers of parsley and parsnip. In the daisy, cornflower, and many other Compositæ, the marginal sterile flowers are gaudy and attractive, very well seen in the ox-eye daisy and the aster, with its showy yellow rays round a fertile but comparatively inconspicuous blue disc. In flower-heads, such as elder, hydrangea, etc., a similar arrangement prevails—the outer flowers of the inflorescence are large and showy, though often barren. Finally, by massing into heads, small flowers make up for their individual defects.

A sentence may be added about plant perfumes. Very often the scent of leaves and stem is intended to warn off herbivorous animals, while that of the flowers is intended to attract insects: garlic is a good example of this. In lavender, woodruff, rue, and auricula the leaves and flowers are scented alike. Many small and inconspicuous flowers are visited by such numbers of insects as to suggest that they possess perfumes, imperceptible by us, but appealing to these visitors. Lastly, the perfume is given off at the very time when the desirable insect usually appears, and is of the desired quality: the butter-bur, fertilised by carrion-feeders, has flowers of the colour and odour of decaying meat.

Next Month:
THE CONFERENCE TOWN.
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HISTORY DAY BY DAY.

March.

1st. *St. David's Day.*—St. David, the patron saint of Wales, was Archbishop of Menevia (now called St. David's) about the close of the sixth century.

2nd. *Sir John Eliot's famous Motion, 1629.*—As Charles evidently showed no intention of acting according to the Petition of Right, Sir John Eliot moved: "Whoever should bring in opinions disagreeing from the true and orthodox Church, whoever should advise the levying of tonnage and poundage without grant of Parliament, whoever should pay these duties, was to be accounted an enemy to the kingdom." This bold motion cost Eliot his liberty; he was committed to the Tower, where he remained till his death.

3rd. *Treaty of San Stefano, 1878.*—Owing to the misdeeds of the Turkish officials, Servia and Montenegro revolted, and in January 1877 a conference of European powers was held at Constantinople to settle the questions at issue. No united action was, however, decided on, so Russia took upon herself the task of coercing the Turkish Government. After a desperate struggle, Turkey was compelled to yield; and a treaty was signed at San Stefano, which secured for the populations of the Christian provinces almost complete independence. Lord Beaconsfield, however, refused to recognise this treaty as valid unless confirmed by a European congress.

4th. *Edward the Fourth proclaimed King, 1461.*—After his defeat at St. Albans, Edward of York fully retrieved his loss by collecting his scattered followers and advancing rapidly on London. As the handsome young prince rode through the streets of the metropolis, he was hailed with cries of "Long live King Edward!" When Parliament met, the partisans of Henry were afraid to venture near London, so the deposition of Henry and the proclamation of Edward were easily carried.

The Forth Bridge opened, 1890.—"Peace hath her victories," and this is one of the greatest. The bridge itself, without its approaches, is 5,350 feet long, contains 50,000 tons of steel, and took seven years to build.

5th. *Battle of Barrosa, 1811.*—After waiting helplessly before the lines of Torres Vedras for several weeks, during which his army gradually wasted away with disease and starvation, Messena ordered a retreat. As the French retired, Wellington cautiously followed, striking whenever an opportunity presented itself. On this day General Graham inflicted a crushing defeat on a large body of French under Marshal Victor.

6th. *Beaumont died, 1616.*—One of the founders of the English drama. Brought up to the bar, he soon quitted the legal profession, and, in conjunction with Fletcher, brought out upwards of fifty plays and poems.

7th. *Admiral Collingwood died, 1810.*—Born at Newcastle, he went to sea when only eleven. In 1776 he was appointed to the *Lowestoft*, in which Nelson was lieutenant, and thus began a lifelong friendship. He took part in "the Glorious First of June," and also in the battle off Cape St. Vincent. Nelson appointed him his second in command; and in the *Royal Sovereign* he led one column into action at Trafalgar. He was awarded a barony and a pension of £2,000 a year.

Reverse at Vryburg, 1902.—Delarey defeated a British force under Lord Methuen, capturing five guns. Lord Methuen, who was severely wounded, was captured by the Boers.

8th. *English Force landed at Aboukir, 1801.*—One of the boldest and most far-reaching of the many schemes which Napoleon laid before the Directory was one for the conquest of Egypt, as a preliminary to an attack on our Indian Empire. He accordingly landed in Egypt, 1798, and met with little or no resistance; but his fleet was destroyed by Nelson, and although he himself managed to return to France, he was obliged to leave his army to its fate. Here it remained for nearly three years, England being too fully occupied elsewhere to take any action against it; but in 1801 Abercromby was sent to Egypt with 15,000 men.

9th. *Murder of Rizzio, 1566.*—By her marriage with Darnley, Mary hoped to unite the Catholic factions, and thus become sufficiently powerful to defy the Lords of the Council, and to make a bold bid for the English crown. Her hopes

were doomed to disappointment, for Darnley turned out so dissolute and worthless that Mary refused him the "crown matrimonial." Attributing this refusal to Mary's counsellor, Rizzio, Darnley burst with his ruffians into the queen's chamber whilst she was engaged with Rizzio in discussing her plans for invading England, and, barely dragging the unfortunate Italian from the queen's presence, he brutally stabbed him to death.

10th. *Candahar captured, 1842.*—After the disastrous retreat from Cabul in January, General Pollock was sent to retrieve the honour of the British arms. On 10th March he captured Candahar, after a severe fight.

11th. *Badajoz taken by the French, 1811.*—This important frontier fortress surrendered to Marshal Soult, and was held by the French for over twelve months.

12th. *Battle of Stamford, 1470.*—Although Edward the Fourth owed his throne in a great measure to Warwick "the King-maker," he was not content to remain a mere puppet in his hands. He declined the French marriage which Warwick was negotiating, and wedded Catherine Woodville, whose kinsmen he raised to the highest positions in the land in order to rival the House of Neville. Warwick replied to this by attempting to place the Duke of Clarence on the throne; but Edward defeated the rebels at Stamford, and Warwick and Clarence were compelled to flee.

13th. *Bloemfontein occupied, 1900.*—On the approach of the British the town surrendered without offering any resistance.

14th. *Lucknow, 1858.*—The Mutiny broke out in Lucknow on May 30, 1857; and Sir Henry Lawrence, after trying to drive the rebels from the city, fortified the Residency, and removed thither all the Europeans. On September 25 General Havelock relieved the Residency, but was unable to dislodge the enemy until the arrival of Sir Colin Campbell. It was decided, however, to evacuate the city, and on November 22 they removed to Alumbagh. In the spring of the following year, the rebels having been defeated in many quarters, Sir Colin Campbell turned his attention to Lucknow. Operations commenced on March 14, and in less than a week the city fell.

15th. *Viscount Melbourne born, 1779.*—Entered the House of Commons in 1805; Chief Secretary for Ireland under Canning; Home Secretary under Earl Grey; Prime Minister from 1834 to 1841. "He was of kindly, somewhat indolent, nature; fair and even generous towards his political opponents. He was emphatically not a strong man." He died 1848.

16th. *Earl of Lancaster defeated at Boroughbridge, 1322.*—Lancaster, who stood at the head of the English baronage, viewed with a jealous eye the sudden rise of the De Spencers. Appealing to the barons, he compelled Edward the Second to banish his favourites to Ireland; but the energy shown by the king in avenging an insult to the queen roused the admiration and sympathy of the people, and, relying on this wave of popularity, Edward defied Lancaster and recalled the De Spencers. Lancaster fled to the north, but was defeated and captured at Boroughbridge. He was afterwards executed at Pomfret.

17th. *St. Patrick's Day.*—St. Patrick, the apostle of Ireland, lived about the fifth century. Though born in Ireland, he was educated in France; and on his return to his native land his missionary efforts were crowned with marvellous success.

18th. *Princess Louise born, 1848.*

19th. *Livingstone born, 1813.*—Born at Blantyre, in Lanarkshire, he worked as a mill-hand whilst he studied Latin, Greek, and medicine. He was sent to South Africa by the London Missionary Society, and explored the valley of the Zeriga and Lake Ngami. In 1865 he started to explore the source of the Nile, and for three years nothing was heard of him until he was found by Stanley at Ujiji, on Lake Tanganyika.

20th. *Cranmer burned, 1556.*—Educated at Oxford, he became a fellow and lecturer in divinity. He suggested the divorce question should be referred to the universities. In 1532 he was appointed Archbishop of Canterbury, and, having given judgment against Catherine, crowned Anne Boleyn a week later. He produced the First and Second Prayer Book for Edward the Sixth. Having favoured Lady Jane Grey, he was committed to the Tower and burned. He was a man of good intentions and kindly disposition, but his weakness and vacillation made him a coward and a time-server.

21st. *Battle of Alexandria, 1801.*—As soon as the French in Egypt found that the English had landed, they rapidly concentrated and attacked them, in the hope of crushing them before they were prepared; but after a stubborn battle, in which Abercromby was mortally wounded, they were obliged to draw off with heavy loss.

22nd. *Rye House Plot, 1683.*—This was a design of Rumbold and a few other desperate characters to murder Charles the Second and the Duke of York, and place Monmouth on the throne. The Crown lawyers, however, also managed to implicate in this foul plot Essex, Russell, and Algernon Sidney, men of noble character, who were endeavouring to form an association to compel Charles to summon a Parliament.

23rd. *The Boer "Government" arrived at Pretoria, 1902.*—This was regarded as an indication that peace was at hand.

24th. *Hyderabad, 1843.*—Lord Ellenborough, the Governor-General of India, accused the Ameer of Sindh of treachery, and dispatched Sir Charles Napier against him. The Ameer was defeated at Hyderabad and Meeanee, and the country annexed. Napier's dispatch announcing the annexation merely contained the Latin word *Peccavi*, "I have sinned."

25th. *Slave Trade abolished, 1807.*—This first step toward the removal of this disgrace to civilisation was carried by Lord Grenville, in spite of a vigorous opposition from the Tories and the merchants engaged in the slave trade.

26th. *Death of Cecil Rhodes, 1902.*—Born in Hertfordshire, 1853, he went to Kimberley, and, making a fortune in the diamond fields, returned to England and graduated at Oxford. He went back to the Cape, entered Parliament, and became premier. He was largely interested in the British South Africa Company, and in colonising Matabeleland. By his will he left £100,000 to his old college, Oriel; he founded sixty colonial scholarships of £300 a year, for three years, to enable young colonists to graduate at Oxford; also two similar scholarships for each of the fifty-one States of America, and fifteen for Germany.

27th. *John Bright died, 1889.*—He first came into prominence owing to his co-operation with Cobden in the Anti-Corn Law League and Free Trade agitation of 1839. As a speaker, he was celebrated for the purity of his language and the independence and sincerity of his opinions.

Treaty of Amiens, 1802.—"A peace," Sheridan declared, "that everybody would be glad of, but nobody would be proud of." By it England abandoned all her conquests except Ceylon and Trinidad, and restored Malta to the Knights of St. John.

28th. *War declared against Russia, 1854.*—The Czar, as head of the Greek Church, claimed the right of protecting the Christian subjects of the Sultan from the cruelties that they undoubtedly suffered. As the Sultan refused to recognise this right, war was declared between the two countries. England, being jealous of any movement southward on the part of Russia, decided to join with France in assisting Turkey.

29th. *Battle of Towton, 1461.*—Edward the Fourth was soon called upon to uphold his new title by the sword. The Lancastrians gathered in great force, and at Towton took place perhaps the most terrible battle that has ever been fought on English ground. Twenty thousand Lancastrians were slain that day, whilst the loss of the victors was almost as heavy.

30th. *Peace of Paris, 1856.*—By this treaty Kars was restored to Turkey, and Sebastopol and all other places taken by the allies were given back to Russia; the Sultan undertook to ameliorate the condition of his Christian subjects; the Black Sea was neutralised, and during times of peace the Sultan engaged to prevent foreign war-vessels passing through the Bosphorus or Dardanelles. This last clause is extremely important just now in view of Russia's recent action in taking unarmed warships through the Dardanelles under a merchant ensign.

31st. *Lord Granville died, 1891.*—Born 1815, he entered Parliament 1836. In 1853 he became President of the Council, and in 1870, and again in 1880, he occupied the Foreign Office.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

A FRAGMENT OF EMPIRE—THE MALAY STATES.

THE native states of the Malay Peninsula were federated, under British protection, in 1898. The redemption of these waste lands is one of the brightest jewels in the crown of British administration, yet how many people are there who could give any account of the work we have accomplished in the Federated Malay States? In this article we shall endeavour to sketch broadly the history and progress of the states during the past three decades.

History.—Our holdings on the Malay coast date back over a hundred and twenty years, but it is only about thirty years since Great Britain began to concern herself actively in the internal affairs of the peninsula, and to see how great was the commercial value of these small states, situated, as they are, at the equatorial centre of the eastern hemisphere where all the ways of commerce cross. Until 1874 the hinterland remained untouched. It is true that commercial treaties were made from time to time with the native rulers, but British authority was strictly confined to Singapore, Malacca, and Penang—the Straits Settlements. Under these conditions the mainland was ruled by numerous petty chieftains, who formed a score of states, and employed their leisure time in warring one against the other. All that was known in England concerning the Malays was that they were "treacherous by nature and pirates by trade."

In 1874 an opportunity occurred for further acquaintance. Civil war broke out in Perak, the northernmost state. Soon the entire state was reduced to anarchy and starvation. The Chinese miners took to piracy, and in an encounter two British naval officers were wounded. Then the legitimate ruler of Perak appealed to the Governor of the Straits Settlements at Singapore for assistance and advice. Both were readily given. The legitimate ruler was recognised by the chiefs, all forts and stockades were demolished, the disputed questions of mining areas were settled, and a British Resident was appointed, "whose advice," the treaty said, "was to be asked and acted on in all questions other than those touching Malay religion and customs." Thus we came to Perak.

In Selangor the same conditions prevailed, only in a minor form. Here, too, a British Resident was dispatched and received in 1874. The other states quickly fell under British protection:—

1875. Sungei Ujong.

1889. Negri Sembilan—nine states round the borders of Malacca.

1888. Pahang.

In 1898 the territories in the peninsula—Perak, Selangor, Negri Sembilan, and Pahang—were amalgamated for administrative purposes under the title of the Federated Malay States.

The Sultan of Johore is now the only independent ruler in the peninsula south of Perak, and his independence is of a limited kind, the foreign relations of the state having since 1887 been in British hands.

Perak and Selangor.—These states, being the most important in the federation, deserve separate notice.

Perak is situated on the west coast of the peninsula. The country is to some extent mountainous, but there are extensive plains. The soil is very fertile, and the interior plains are clothed with luxuriant and valuable forests, yielding rubber, guttapercha, and gums. Elephants, leopards, huge snakes, and deer inhabit the plains and jungle.

The chief product is tin, and gold has been occasionally met with; then come rubber, guttapercha, gums, rice, sugar, tobacco, tea, coffee, vanilla, and spices. The tin trade is chiefly in the hands of Chinese miners, who form a considerable section of the population. In 1876 the yield of tin was 2,060 tons; nineteen years after this it had increased to 23,866 tons. Great quantities of lead are also found.

The population, which consists chiefly of Malays and Chinese, is rapidly increasing. Railways have been built, good roads constructed, and the country is now in a prosperous condition.

Selangor is situated south of Perak. The area is 5,000 square miles, and the population 140,000, mostly Chinese. The country is rich in tin; and rice, tapioca, and sugar are also exported.

It may be useful at this point to summarise the exports, and give the value of exports, imports, revenue, etc., of the Federated States.

Exports.—Tin (five-sixths of the world's supply comes from Malaya), gambier, tapioca, rice, sugar, tea, cinchona, spices. The value of these is steadily increasing year by year.

Year.	Imports.	Exports.	Revenue.	Expenditure.
1901...	£3,952,000	£6,311,000	£1,754,000	£1,727,316

From these figures it will readily be seen that the states are self-supporting, and that their commerce is considerable. Indeed their chief value to Great Britain exists in their commercial importance.

People.—The Malays of old were not very estimable personages, but they have improved wonderfully since they were first brought under British administrators. They have now abandoned their lawless habits, and are described as mild and patient people, occupying themselves with agriculture and trade. Their intellectual standard is low, and all evidences of culture appear to be due to Hindu or Arab influences.

The Malay language is soft, harmonious, and of simple structure. Unfortunately it is written in Arabic characters, which are ill suited to it. An attempt has been made during recent years, with much success, to introduce Roman letters in place of Arabic.

Contrary to what one might expect, the Malay literature is copious. It consists of love songs, dramas, and poetic compositions of all kinds, which display much originality but little imagination. The prose writings are based on Arab or Persian models, and comprise treatises on law and ethics, and histories—a pot-pourri of truth and fiction.

Progress, 1874–1901.—The progress made by these states in less than thirty years may be gathered from a recent Blue-book.

	Revenue, 1875.	Revenue, 1901
Perak	$226,333	$8,500,000
Selangor	$115,656	$6,544,796
Negri Sembilan	$67,405	$1,699,353

"The revenue of these three states has thus multiplied within the last twenty-seven years forty times over. The value of their import and export trade, which twenty years ago was about 11,000,000 dols., is now over 100,000,000 dols., an increase in a couple of decades of more than nine hundred per cent. The first year for which trustworthy figures are available for Pahang is 1892. They show that even within the last ten years the revenue of the Federated Malay States has more than trebled, their imports more than doubled, and that their exports are all but three times as valuable as they were." Here are some comparisons:—

1875.	1901.
1. Not a single mile of cart-road.	1. 1,366 miles of cart-roads and 1,000 miles of bridle-paths.
2. No railways.	2. 340 miles in working order.
3. Native education confined to learning Koran by rote, and a Malay who could read or write was a curiosity.	3. 209 vernacular and state-aided schools, with over 9,000 pupils.

Hospitals were formerly unknown institutions, and cholera and smallpox ran their course unchecked. To-day there are Government free hospitals, prison hospitals, and lunatic asylums; and cholera and smallpox have been practically extinguished.

During the last decade the population has increased by sixty-two per cent., the Malays alone having risen from 230,090 to 312,456.

A well-organised regular police force, over 2,000 strong, officered by Europeans, has taken the place of the old body-

guard; and an efficient regiment of Malay State Guards is in constant training.

"Wharves, harbours, drainage, and irrigation works, forestry, Government offices, posts, and telegraphs—in fact, all the material necessaries of a great state, down even to motor cars, have been introduced."

Conclusion.—But what has been the effect of this Western civilisation upon the people of the states? A recent writer thus answers this question:—"The reply is that it has brought to the rulers an entirely new sense of their duties; that they are no longer cruel and capricious voluptuaries, but recognise that they owe something to their subjects—a something that can best be discharged by showing a personal interest in their lot, and by furthering the schemes promoted by their British advisers. And as to the peasant, British rule has given a security of life and property of which in the old days he knew nothing. It has given him a permanent title to his land. By road and rail it has opened up undreamed-of markets to his produce." It has abolished all forms of slavery, arbitrary taxation, forced levies, and compulsory labour.

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

Moral Training.

Character Training.

THE subject I am submitting for consideration is one to which I have given much anxious thought. To many it would appear that the character side of the primary school curriculum receives due attention. Have we not a daily dose of religious instruction? Granted; but can we justly say that this instruction is always calculated to play the part it should in the moulding of character? If so, would not a little more of it in secondary schools be useful? No; the fact is our religious instruction is not sufficiently interwoven with the so-called secular portion of the course. For Cowper-Temple and other reasons a great gulf has been fixed between conscience clause *alias* sacred and non-dogmatic *alias* secular subjects. The consequence is that our primary school children receive little purely *ethical* teaching apart from what may be given as subsidiary to a knowledge of biblical history.

Ethical Teaching is given in other Countries.

At many ladies' schools systematic instruction is given in ethics. In America much is being done in the way of systematising moral instruction. "Direct moral lessons are given at the opening of the day in some places (for example, Louisville, Kentucky); in others they are called lessons on 'manners and morals' (Brooklyn), and include instruction in 'table manners,' duty to strangers, to the stupid, etc. There is a 'Kind Deeds Society,' and a society for the protection of birds; both are connected with school work" (*Reform of Moral and Biblical Instruction*). The French have, since 1886, given definite teaching in morality and civic duty in their schools. In Germany, Herbartianism, the very essence of which is culture training, is making headway.

Religious Instruction to be linked with the other Subjects.

We have heard much latterly of the co-ordination of subjects. May we not apply this principle to our moral training? There are some who think that character-building is all a matter of example, and that whilst all other subjects should appear on the time table, the most important—namely, moral instruction, apart from the distinctly biblical—should be thrown in haphazard whenever occasion serves. Let us for a short time confer with those who think otherwise.

History as an Ethical Subject.

History, of course, is *par excellence* the subject which affords the best opportunities for culture training. Its ethical value is well set forth in Mr. Rooper's monograph, *New Methods in the Lower Standards*. After classifying studies thus—(1) Acquirement of facts, (2) Expression of facts, the writer illustrates (1) thus—

Stories from (*a*) The Bible: David and Goliath.
(*b*) Home Life: Nelson's Boyhood.
(*c*) History: Martius Torquatus.

And (2) thus—

By speech—(*a*) Speaking, word-building. Pictures of Nelson's Boyhood.
(*b*) Reading: Story of Nelson.
(*c*) Recitation: England's Dead.
(*d*) Singing and voice-training: Hearts of Oak.

Mr. Rooper writes: "The stories of David and Goliath, Martius Torquatus, and Nelson, all illustrate the virtues of courage and love of country. The recitation illustrates the same spirit of willingness to die, if need be, in the country's cause. The song repeats the same theme."

History as a Means of Teaching Citizenship.

In another passage Mr. Rooper shows the direct bearing of all history on civics:—"I would place stories from history next to those dealing with home life; and while I would give the preference to stories that are connected with the history of England, and particularly with the locality in which the child lives, I would also appeal to the histories of all nations, and especially of Greece and Rome. Many of the stories of both Greek and Roman heroism are as near to the understanding of the simplest child as are the reminiscences of his grandmother; and I believe that if you seek for concrete illustrations of great ideas like My Country, Government, Anarchy, Freedom, Privilege, Patriotism, and the like, you will more readily find them in ancient than in modern history. No boy, nor girl either, can listen to the story of the faith of Romulus, the courage of Scævola, the sacrifice of Curtius, or Spartan endurance and heroism, without being elevated and inspired by these examples."

Suggestions for a Scheme.

Do not let it be understood that I consider these matters totally neglected in the schools. I only plead for more definite courses. We have our guilds of courtesy and our occasional conversational lessons in infant schools upon the wickedness of ill-treating donkeys. In many schools, especially Roman Catholic ones, I obtain frequently abundant evidence that "manners" are not neglected.

There is room, however, for definite lessons, which should embrace such matters as:—

1. Self-sacrifice in its widest sense—that is, consideration for others, including—
   (*a*) Reverence for one's parents.
   (*b*) Respect for the aged.
   (*c*) Kindness to the afflicted and the sick.
   (*d*) Protection for the weak.
   (*e*) Kindness to animals.
   (*f*) Respect by boys and men for girls and women.
2. Temperance in eating, drinking, speaking, etc.
3. Cleanliness, punctuality, and politeness.
4. Citizenship.

Many of these topics can be taught practically. Example should always accompany precept where possible.

The girls at a school might be encouraged to dress dolls to be taken to the children's hospital. Boys and girls might bring flowers for presentation to the hospital.

In mixed schools boys can be made to give way to girls—to open the doors for them and for visitors. The teachers can do much by watching their scholars in the playgrounds. They should be careful not to interfere too much, but when the bigger boys hustle the younger ones there would be opportunities for teaching what is right.

Punctuality and cleanliness are necessarily part and parcel of the discipline of every school. The advantages hygienically of cleanliness should be dealt with.

I suggest one lesson a week at least, in addition to the biblical lessons, for what may be called ethical teaching.

It would be advisable to have a good reading book, if such there be, on courtesy, for use in the upper standards.

THE "NOTEBOOK" QUERY COLUMN.

Letters intended for this column should be addressed "Inspector," care of Editor, PRACTICAL TEACHER. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

H.P.H. desires to raise certificate, and wishes to know if he must read, recite, and teach again. He also has a similar

grievance to "Justice" (January *Practical Teacher*), and seeks my advice thereon.

Answer.—I have seen a recent official reply which said candidates such as "H.P.H." should read, recite, and teach again. His managers might write to the Board, giving fully his qualifications, and obtain a definite ruling; but I do not think any other course but taking the whole examination *de novo* will be possible.

M. W. asks whether personal application must be made by candidates for pupil teacherships to the Board of Education to sit at the examination in April next.

Answer.—In due time your managers will be notified of the date of the examination, and will be requested to forward the names of all candidates who are desirous of sitting. You need therefore not worry.

Cranbourne asks: "Will inability to pass in drawing cause a certificate candidate to fail? If not, will you kindly inform me what are the failing subjects?"

Answer.—Drawing is not a failing subject. Arithmetic and English, as well as reading, recitation, and teaching, are.

PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

FOURTH LESSON.

Dumb-bell Exercises and "Model Lesson, No. 1."

(The words of command are in heavy type.)

NOTE.—45. In commencing to teach exercises, a word or number must be given as a command for each movement. This is known as learning (or teaching) "**by numbers.**" When, however, a certain degree of proficiency and accuracy of position has been acquired, the class may be told to perform the whole exercise, "**judging the time.**" The caution and command would therefore be:—

46. "**First exercise, sixteen times (or movements), judging the time—Commence,**" when the class should commence, perform, and finish the exercise in perfect unison. Time may be kept by the teacher tapping the floor with a pointer, or, better still, by the aid of music (piano, etc.).

This word of command may be used either for dumb-bell, bar-bell, or physical exercises, the latter of which merely require combination and repetition, and may then be performed to musical accompaniment. Such combinations will be given from time to time, but much may be left to the teacher's discretion.

In teaching dumb-bell exercises to children, it is better that the exercises should first be taught thoroughly without dumb-bells, the pupils' hands being tightly clenched, as in the act of grasping, whilst performing the various movements. Light wooden dumb bells should be provided for children at the age of eight, and small iron dumb-bells, weighing not more than one pound, for children of twelve or thirteen.

DUMB-BELL EXERCISE, No. 1.

47. "**First exercise, first part.**"—On the word "**One,**" raise both hands above the shoulders, upper arms horizontal, fore arm above the upper arm, fists clenched and immediately above the point of the shoulder.

"**Two.**"—Strike sharply out to the right with the right hand, to the full extent of the arm, keeping the arm in the horizontal line.

"**Three.**"—Strike out with the left hand as directed for the right, and at the same time draw the right hand sharply back to its place, as in first position.

"**Four.**"—Draw in the left hand and strike out with the right, etc.

"**Five.**"—As detailed in "Three."

"**Six.**"—As detailed in "Four."

"**Seven.**"—As detailed in "Three."

"**Eight.**"—Draw in the left hand, whilst keeping the right

FIG. 1.

at its place above the shoulder, and resume the position described for "One."

48. "**First exercise, second part—One.**"—Strike out to right and left with both hands simultaneously, hands in line.

"**Two.**"—Bend both arms, and bring the hands into position above the shoulders.

Continue "by numbers" until seven is counted, when both arms will be extended, and then on the word "**Eight,**" drop both arms smartly to the sides.

DUMB-BELL EXERCISE, No. 2.

49. "**Second exercise, first part—One.**"—Raise both arms straight to the front, hands in line with the chin, about six inches apart and closed, the backs outwards to right and left.

"**Two.**"—Throw the hands smartly back in a line with the shoulders, arms straight, backs of the hands to the rear, at the same time rising on the toes as high as possible, leaning *slightly* forward, breast advanced.

"**Three.**"—Resume the position described in "One," sinking on the heels as the hands are brought forward.

"**Four.**"—As in "Two."

Repeat these motions until the seventh is performed, and on the word "**Eight,**" throw the hands back, rising on the toes as already described, and without pause allow the arms to fall smartly to the sides, and sink on the heels.

50. "**Second exercise, second part—One.**"—Raise both arms sideways above the head until the backs of the hands are some eight or ten inches from each other, still closed, arms straight, head thrown slightly backward (Fig. 1).

"**Two.**"—Lower the arms quickly sideways to the sides.

Continue these movements "by numbers," and on the word "**Eight,**" lower the arms as before, but allow the hands to pass in front of the thighs until the fingers rest on the thigh.

51. "**Second exercise, third part—One.**"—Raise the right arm straight to the front and above the head, back of the hand to the rear, the body not to be allowed to bend over to left or right, but held erect (Fig. 2).

"**Two.**"—Lower the right hand to its former position in

front of the thigh, at the same time raise the left in the same manner as described for the right in "One."

Continue these movements until fourteen is counted, and on the word "**Fifteen,**" keeping the left hand above the head, raise the right also, both hands now being raised, back of the hands to the rear.

"**Sixteen.**"—Lower both arms quickly outwards or sideways to "Attention."

DUMB-BELL EXERCISE, No. 3.

52. "**Third exercise—One.**"—Bend the arms at the elbows, raising the hands until they are in line with the shoulders and about fifteen inches apart, the finger-nails to the front, the head erect, chest advanced, the shoulders forced backward.

"**Two.**"—On the word "Two," push the hands smartly to the front in line with the shoulders, arms fully extended, back of the hands upward, and separated fifteen inches as before.

"**Three.**"—As in "One," arms bent, etc.

"**Four.**"—Extend the arms smartly above the head at the same distance apart as before, fingers to the front, head thrown slightly backward. (It may here be observed that as a general rule in physical or dumb-bell exercises, whenever the hands are above the head, the head should be inclined backward, eyes directed upward.)

"**Five.**"—As in "One."

"**Six.**"—Extend the arms smartly to the right and left (outwards) in line and level with the shoulders, back of the hand upwards.

"**Seven.**"—As in "One."

"**Eight.**"—Drop the hands smartly to the position of "Attention."

Repeat the whole exercise three or four times.

DUMB-BELL EXERCISE, No. 4.

53. "**Fourth exercise—One.**"—Lunge to the right (as described in No. 24, Fig. 3, Second Lesson), keeping the shoulders square to the front; at the same time raise the

FIG. 2.

arms outward in line and level with the shoulders, palms of the hands upward, head turned to the right, eyes directed toward the right hand (Fig. 3).

"**Two.**"—Recover as before described (24, "Two"), placing the hands on the hips. If holding dumb-bells, place the knuckles firmly on the hips, back of the hand downwards.

"**Three.**"—Lunge to the left as described in No. 25, and raise the arms as in the right lunge, turning the head and eyes to the left, shoulders square to the front.

FIG. 3.

"**Four.**"—Recover as before, bringing the left foot smartly back to the right and the hands to the sides, as at "Attention."

If desired to repeat the exercise, say four times, the hands will be placed on the hips at every recovery except the last, or sixteenth movement, when the pupils will drop the arms as directed in "Four."

In dismissing a class on the completion of a lesson, the command is as follows:—

54. "**Dis—miss.**"—On this command the class will turn to the right, make a pause equal to the duration of two steps in quick time, and then move away quietly, and independently of each other.

"MODEL LESSON" No. 1.*

Below will be found the words of command for a "Model Lesson," for pupils at the end of the third month, who are supposed to have made reasonable progress.

It should be quite possible to perform the whole of these movements well within half an hour, repeating any which are not performed to the satisfaction of the teacher.

"In two ranks—Fall in" (31).
"Class—Attention" (2).
"Right—Dress" (3).
"Eyes—Front" (4).
"Class—Number" (5).
"Right—Turn" (9).
"Class—Front" (11).
"Left—Turn" (10).
"Class—Front" (11).
"About—Turn" (33).
"Class—Front" (11).
"Form—Fours" (34).
"Class—Front" (35).
"Form—Fours" (34).
"Right" (36).
"Class—Front" (37).
"Right—Turn" (9).
"Quick—March" (12).
"On the toes—Rise" (43).
"Quick time—Quick" (44).
"Mark—Time" (13).
"Class—Halt" (14).
"Class—Front" (11).
"Stand—Easy" (8).
"Class—Attention" (2).
"Open out—March" (32).
"Right—Turn" (9).
"Hands on—Hips" (15).
"Bending the knees—One, two, three, four, etc." (26).
"Bending to the right and left" (27).
"Bending forward" (28).
"Bending backward" (29).
"Combined exercise" (30).
"Re-form ranks—March" (7).

* The numbers refer to the paragraphs in which the explanation of the commands will be found.

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

OUR COMPETITION PAGE

OUR FRENCH PRIZE COMPETITION.

Prize Editor—W. T. THOMPSON, B.A. (LOND.), *French and German Honours.*

Important to Scholarship, Certificate, and London Matriculation Students.

WE should like to specially direct the attention of our readers to the fact that the Board of Education, in the Syllabuses for the Scholarship and Certificate Examinations 1901 and 1902, requires "no set books" for French and German. Students preparing for these examinations, as well as students for London Matriculation, could not do better than attempt month by month the pieces set for translation here. They are from the best authors, and of varied character. A competitor who does not gain a prize can derive considerable benefit from the exercise. A study of the successful competitor's translation, and of our remarks, will help him to see where he might have done better. If desired, his paper can be returned (fully corrected) by enclosing six stamps together with a stamped and addressed envelope. Corrected papers cannot be posted until after publication of the journal.—ED.

RULES.

1. All translations should be **posted not later than March 8,** and addressed:—*Prize Editor*, Office of the PRACTICAL TEACHER, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.

ALTERATION IN RULE 3.

3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

FRENCH PRIZE COMPETITION.

A Prize of One Guinea will be given for the best translation into English of the following extract:—

Allons donc! cria Fincken, L'Alsace appartenait naturellement à l'Allemagne; elle lui a fait retour: nous assurons la reprise de possession. Qui est-ce qui n'en ferait pas autant?—La France! riposta Oberlé, et c'est pour cela que nous l'aimions. Elle avait pu prendre le territoire; elle n'avait pas violenté les âmes. Nous lui appartenions par droit d'amour! Le baron leva les épaules:—Retournez-y donc!—Jean faillit crier: "Oui!" Les domestiques s'arrêtaient de passer les gâteaux pour écouter. Il reprit:—Je trouve donc mauvaise en soi votre tentative, parce qu'elle est une oppression des consciences; mais je trouve aussi qu'elle est maladroite, même au point de vue allemand.—Charmant! dit le fausset de Madame Knäffle.—Vous auriez tout intérêt à conserver ce qui peut nous rester d'originalité et d'indépendance d'esprit. Ce serait d'un exemple utile en Allemagne—Merci, dit une voix—Et de plus en plus utile, insista le jeune homme. J'ai été élevé en Allemagne, je suis sûr de ce que j'avance. Ce qui m'a le plus frappé, et choqué, c'est l'impersonnalité des Allemands, leur oubli grandissant de la liberté, leur effacement devant le pouvoir de.....Prenez garde, jeune homme! interrompit vivement le conseiller Brausig.—Je dirai devant le pouvoir de la Prusse, monsieur le conseiller, qui dévore les consciences et qui ne permet de vivre qu'à trois types d'hommes qu'elle a modélés dès l'enfance: des contribuables, des fonctionnaires et des soldats. RENÉ BAZIN.

RESULT OF THE FEBRUARY COMPETITION.

The prize is awarded to "Kyleside." (Will "Kyleside" please send name and address?)

First Class.—C.E.M., Ethik, Pegarita, Buxtona, Q.U.A.Y., Aiphos, Holm, Retlaw Rettop, Field Hill, Myosotis, St. Fittick, Agaznog, Festina lente, Nell of Tarc, Yellow Ant, M.F.E., Davy Brown, Moffat Hartfell, Jabberwock, J.D.A., Traduzco, Fidelis, Nannette, Editha, Malvoisie, Tyro, Quality Street, Central, Hessary, Freda, Carma, Plain Mary, Irénée, Ouard, Bull-dog, J.E.C., Moloch, Lièvre, Elgin, Stulta, Campsie Fells, The Muir, Tancredi, Bonnie Briar, Veritas, Chemineau, G.M.L., Deveron, E.A.C., Grecian, Mountaineer, Trellis, Marquise, Holker, Radnor, Royal Hibernian, A. Bhoidheach, Sotonian, Veronica, H.M., Rubicon, Blancheuse, Quasimodo, Jeanne Bontemps, Paradox, Frog, Ginger, Perseus, Yorick, Chêne, One of them, Philomena, Neilson, Bun Jonyan, Scotia, M.L.A., E.A.E., Ende gut Alles gut, Gladiator, Primrose, Fabien Mouillard, Nancy, H. de V., A.M.T., Orion, Ley Bent, Sheila, Helvetia, Wessex, E.C., Redvers, Nellie, Setebos, Creechy, Aux dames, A.J.J., Day Dawn, Ta Donnaichaidh, Elise, Caldergrove, A.M.S., Débutante, Ambrosia, Strath, Helen, Margaret, Nettle, Cedric, Raven, Ephesian, Ed Eth, Primrose, Kettering, Ruffle, Hereward, Léonard, Margot, Stretton, Tsenre Enotsnaw, Maryl, Little Mitey, Lil, Florothy, Cinderella, Psyche, Orang Outang, Haidée, Jester.

Second Class.—Neppydhu, Chiffon, Posy, Violin, Mynoduesp, Jessica, Critchon, Encore, Marwenne, Portia, A Celt, Norah, Ould Oireland, Utopia, Gregnolosene, Huddersfield, Excelsior (Swansea), Quelqu'une, Bernardine, C.K.M.Y., Croissant, Goorkha, J.K.W., Petite amie, Toroy, Geogony, Excelsior, Thule, L'abeille, Précieuse, R.E., St. Ninian, Alethea, Brigitte, Ironopolis, Achisius, Greville, La neige, Lotus, Janet, Micho, L.S.D., Une anglaise, A.W.M., Aramis, Una, Tigris, Jeanne d'Arc, Excelsior (Dudley), Anon, Gorgon, Kismet, Ripa, Gilliflower, Isola, Mist, Inky, Oberon, Cardiff, Véronique, Bronwen, K.A.S., S.A.R.S., Hovan, Daisy Bell, Fred, Nobody, Ivor.

Report.

The number of competitors this month is one of the largest we have ever had, but the translation was hardly done as well as we expected. Many really good papers were nevertheless sent in, although, considering how few difficulties the piece presented, the number should have been greater. *Police* puzzled some, and very many did not connect *la mort* with *de leurs compagnes*. The peculiar sense of *agonies* in French escaped many. Somewhat strangely, some candidates who translated *police* and *agonies* by the English words nearest them in form rendered *langue* by its derived meaning of "language."

The prize-winner of the December French Competition ("U.V.F.L.") is Miss E. F. Murrell, New Estate, Saxmundham, Suffolk.

Prize Translation.

But the whole truth must be told. Amid the marvels of their industry, their social system, their forgetfulness of self, one thing will always take us by surprise and check our admiration—namely, their indifference to the death or misfortune of their companions. In the character of a bee there is a very curious contradiction. Within the precincts of the hive all are loving and mutually helpful. Closely united, like good thoughts in a single soul, if one is attacked, a thousand will sacrifice themselves to avenge the injury. Outside the hive they are strangers to one another. Crush them, maim them—or rather refrain from doing anything of the kind, for it would be useless cruelty, the fact being unquestionable—but supposing that you do maim them, that on a honeycomb placed a few feet from their hive you crush ten, twenty, or thirty from the same swarm, those you have not touched will not even turn their heads, but will go on sucking with their tongue, fantastic as a Chinese weapon, the juice which they value more than life, heedless of the agonies whose last convulsive movements reach them, and deaf to the cries of distress on every side. KYLESIDE.

The Practical Infant-School Teacher.

OUR MODEL INFANTS' SCHOOLS.

XIII.

"We thank Thee, Lord, for this our food,
But more because of Jesus' blood;
Let manna to our souls be given,
The Bread of Life sent down from Heaven,"

FROM the editor's office to the school about to be described is not a very long distance. The day, however, is wet and uncomfortable, so that the journey is not altogether a pleasant one.

The train from King's Cross hurries along, and by-and-by a descent is made from the rather high station into the street below. Shops are few and far between, but long roads lined on either side with houses are indicative of the character of the place. The houses are inhabited by a fairly well-to-do set of people.

The school is not difficult to find. The very first person met with knows it to an inch. "You go along there, then turn to the left, and in a few minutes you'll see it."

Following these instructions, it would be impossible to make a miss; for on turning to the left, lo, there, clear in sight, was a pile of bricks and mortar and stone that could be no other place than a school.

It stands well to itself on an immense piece of land surrounded by a rather low wall with artistically-arranged iron railings growing, as it were, out of it. It is sometimes a difficult thing to light on the right gateway of these large schools at the first attempt. So sure as you go this side, the entrance is on the other. On this particular visit there was no need to go on the other side, for there over the gate were cut in stone the words, INFANTS' SCHOOL.

The playground was practically empty, although the schoolbell was sounding the signal for afternoon assembly; but the practised eye soon detected that as the rain was coming down hard and fast, and some of the teachers had stayed in school for dinner, the doors were open, and the children were allowed to enter as they arrived without the common playground formation of lines.

On crossing the yard it soon became clear that the arrangement on rainy days was for the children to assemble in the corridor of the school. On entering the building a good number of long lines of children were the first thing to be seen, and near the doors of the cloakrooms (there were three of these) the teachers were helping the children to disrobe. They needed it, too—overcoats, and shawls, and capes, and mackintoshes were worn by almost all of them; some, indeed, had to remove goloshes from their feet. The teachers were exceedingly kind to their little charges, and with cheery voice and a pleasant "How very wet you are!" the children were soon comforted.

The mistress, for the moment, had not arrived; but by the time the children were standing in their lines waiting for a signal, she came in. She had no eye for a visitor, no time to say "How do you do?" and no inclination for anything, until the classes had marched away. Without the loss of a moment a bell was brought to her by a pupil teacher, and at its sound every voice was hushed, every movement stayed. Another sound and the children turned, counting "*One, two*" with their feet as they did so. "*Eyes closed!*" as a command from the mistress brought the children into an attitude for prayer, with eyes shut, and hands clasped together, and heads slightly bowed.

was very prettily sung; soft and mellow it sounded down the length of the corridor. In a moment or two, and entirely without a signal, the children assumed their former position. Then the order, an unusual one but a very effective one, "*Quick walk!*" was given, and the children stepped briskly away. Where they stowed themselves was a wonder. There were about six hundred of them; but they went somewhere, and knew exactly how to find the place. In one minute by the watch the corridor was empty, save for the mistress and the visitor.

"Well, sir, and what can I do for you?"

"May I see your school, please?"

"Yes, certainly; we are always very glad to see visitors."

"And may I make use of what notes I take for publication in the *Practical Teacher?*"

"Ah, that is a different matter. The Government inspection took place less than a month ago, and I am afraid I cannot show you anything worth publishing. The children are all commencing new work."

There was need of a little coaxing and diplomacy. Being assured that a description of a school during its early stages of work would be as interesting as one would be at its close, she consented, but very reluctantly.

Clothes and umbrella having been put away, a peep at the hall—a large, square room, with a platform erected at one end—was taken. No children were here. The hall is reserved purely and simply for drill and mass work, and admirably it must suit the purpose. It contained a piano and many kinds of apparatus for physical exercises. None of these, however, were taken on the afternoon of the visit.

The museum in the hall was a very handsome one—a better one could hardly be imagined or desired. It contained several partitions, and was opened by means of sliding glass doors. One of the partitions has since been photographed, and is shown here as an illustration. It is literally crammed with objects, all useful in teaching. The reader will see for herself the arrangement that is carried out in the display of the specimens. The top shelf is given over to cardboard models, which are used in the baby-rooms; the two next from the top to birds and other animals; the next to various subjects, geography and such like; while the bottom one is reserved for the spoils of the seashore. Asked as to how so varied and numerous a selection had been gathered together, the reply came in one word, or rather two, "Enthusiasm, sir."

"If we want a new specimen," the mistress continued, "we write to a London firm, put our case as nicely as possible, and it is seldom we are refused. That churn you see was given by a well-known toy-dealer, and the horse's hoof by a jeweller."

"But the stuffed specimens—surely those are not given away?"

"Well, no, not exactly *given* away. We get the carcasses for nothing in many different ways, and we pay for the preservation ourselves from the school fund."

This way of getting together a good case of specimens is

common enough. Where the system fails is, perhaps, the fault of the mistress, who does not plead often enough. Mistresses are recommended to try other firms if one fails, and not be disheartened at the first refusal.

The bottom shelf of the case has been entirely procured by the children themselves. Holiday after holiday sees the number of shells, eggs, starfishes, etc., renewed and increased. The rabbit on the second shelf from the top is a rough cloth one stuffed with wool, and so is the miniature ostrich.

The baby-room for boys—we did not see the girls'—was just recovering from a shock. One of the new admissions had been brought in late by his nurse. Screaming at the top of his little voice, and stamping on the floor with his goloshed feet (happily without adding to the uproar), he had declared he did not want to come to the nasty school, but wanted to see Father Christmas. He had been calmed down somewhat, and was whimpering in the centre of the room. Hearing the door open he lowered his shut fists from his eyes, and seeing the mistress enter he suddenly, and without the slightest sign of a break, stopped. It was like magic. It seems he had been through the same scene before, and the mistress had had to use her influence to get him round. She now spoke very kindly but at the same time firmly to him; and before very long he was wearing round his neck, just like the others, a large square piece of cardboard with the letter O printed on it in deep black. The teacher was teaching this letter, one of the first to which the children were introduced. They made the same shape with their mouths, and were told to make a sound without altering the shape of their lips by blowing through them. There was quite a chorus of "O's"—loud, long, and sustained. They got tired, though; and when peace was restored they were set to use those two round things in their faces called "peeping O's" to find other O's in the room. The teacher had placed a few about previous to the lesson—a round framed photograph, a ball, the lid of a round tin can, and a toy cart from the museum with two round wheels, were among those that could be seen. They were collected together and placed in full view in front of the children, and each called letter O. Then O was made on the blackboard and drawn by the children with their fingertips in trays, on the bottom of which some fine white sand had been strewn. The number of ways in which this particular letter was repeated and impressed on the minds of the children was a splendid piece of work on the part of the teacher.

THE MUSEUM.

The modulation and tone of the teacher's voice, too, was a wonderful example of strategy. The children were *compelled* to imitate, and in imitating they copied a most desirable way of speaking.

Letters are taught according to their *sounds*, and not by their names. This seems to be the most general way nowadays. Certainly the mistresses who adopt this method speak in high praise of it. It is the same in the higher classes with regard to reading. The following words were pronounced in another room later on in the afternoon by children of six: *Kiosco*, *victoriously*, *annihilated*, *escort*, *intercommunication*, and *misery*. It is true that they did not know what the words meant, but they pronounced them on the letter-sounding system with perfect accuracy. The reading in an ordinary standard reader is very nice indeed, and all the teacher of the standard class has to do is to procure a good modulation of voice and expression. This is done by pattern-reading and imitation.

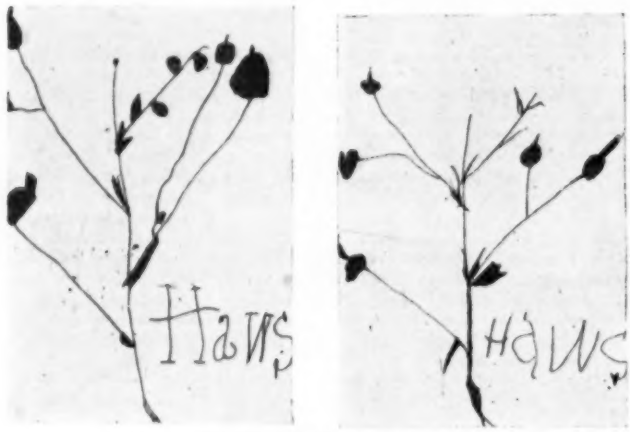
Hand-writing is done entirely on paper, except that in the baby-rooms; and there, as has already been said, it is done in sand.

By the time a visit was paid to the next room reading was over, and the children were preparing for a drawing-lesson. This lesson, and the way in which this subject is taught throughout the school, were so interesting, that watching it and talking over the method took up the remaining part of the afternoon. It will be well to deal with it exhaustively. It will, it is hoped, be specially encouraging to teachers who contemplate adopting this method, and to all it is most sincerely recommended.

What is wanted, first of all, is to get the children interested in the subject of the drawing-copy. In this case it is a spray of hawthorn, and the lesson shall be given as nearly as possible in the teacher's own words. Emphasis in speaking is a great factor of the lesson, and the words the teacher emphasised are in italics:—

"Children, I went for a *walk* last week when we had a holiday. Perhaps some of *you* went for a walk. [Several of the children here wanted to say, "Please, teacher, *I* did."] Yes, I see that most of you did. I went *down* the lane, *over* the stile, and *across* the field till I came to a *little* brook. The water was *so* clear that when I stopped and looked *into* it I saw something. What do you think I saw? ["Fishes."] *No;* I did not see *one* fish. I saw something else. I saw my *own* face. If *you* had been there, and if *you* had looked into the water, *you* would have seen *your* face. But I didn't stop at the brook; I let it go murmuring by, and I walked along that *nice* path that leads alongside the hedge. I saw several birds; I saw that little bird that comes and picks up the crumbs you put out in winter. Yes, the robin; and that *nice* little bird with *nice* brown clothes, the sparrow, and one

or two larger ones. I saw the thrush and the blackbird. And I saw a great *number* of birds all together on the grass, *all* dressed in black. And I heard them talk to each other.



PENCIL DRAWINGS—EARLY PART OF YEAR.

What do you think they said? They said, 'Caw, caw.' Yes, they were crows. All these things I saw in my walk; and yet I did not go for the purpose of seeing *them*. Do you know, children, I went to fetch something for *you?* I knew that when you came back to school after the holidays you would want a *drawing*-copy. And I brought one—a *nice* one, one that I think you will *all* draw *well*. It is under this piece of clean tissue-paper; see how carefully I have kept it for you. I hope you will all be as careful with your drawings. Now we will have a look at it."

The children's interest was thoroughly roused. They looked earnestly while the teacher uncovered the copy: it was a spray of hawthorn, with a few berries here and there. A little further chat, which need not be repeated, finished this part of the lesson. Then the teacher pinned it to one corner of the blackboard, putting under it a piece of clean white paper, so as to make it plainly visible by all. Next, she made a rough drawing of it, full size, on the blackboard, the children watching. As she went on she kept up the interest of the class by pointing out its parts—which to draw first, which next, and so on. Then the copy was completed. Quite a novel feature was now introduced into the lesson. The children held up their pencils, and at arms'-length traced the lines, as it were, in the air, the teacher going to the back of the class to see that it was done correctly. This gave the children some idea of the form of the copy. Then the children set to work. They had small papers to draw upon, the actual size being 5 inches by 4. They made the drawings quite fill the paper. Some of them were very nicely done, and very good specimens of work could have been selected; but two have been chosen for reproduction which are, if not the worst, very nearly the worst. The school was visited during the first month of the year, and the specimens shown should encourage those who are somewhat faint-hearted at this period of the year. At the end of the year, when twelve months' patience and care and perseverance have been spent, the work of this school will compare favourably with that of any school in the country. *Courage, mes institutrices de petits enfants!* Look at the next illustration; it is an exact reproduction of a piece of work done in the corresponding class at the end of a year's instruction.

NATURE DRAWING AT END OF YEAR.

After the children had been allowed to run into the playground for a minute or so, and they had returned, they set to work at the same copy with colour and brush. Here also some specimens are reproduced, and one—"A Happy New Year"—from another class which had gone through the same kind of lesson with a piece of mistletoe for a copy.

All the drawing is taught in this way throughout the year. The children get instruction first on the subject of the copy; then they draw with a firm point; afterwards they use the brush. Some care is taken with printed characters, as may be seen from the mistletoe-drawing.

In addition to the instruction they get on the drawing-copy immediately before the lesson, it sometimes happens that the same specimen has been the subject of an object lesson or a lesson in oral composition. In these cases the previous information is very valuable. A glance at the list of object

COLOUR DRAWINGS—EARLY PART OF YEAR.

TIME TABLE.

Classes.	10 to 10.30.	10.30 to 11.	11 to 11.10.	11.10 to 11.35.	11.35 to 12.	12.		2.10 to 3.10.		3.10 to 3.20.	3.20 to 3.50.	3.50 to 4.20.	4.20 to 4.30.
Babies.	Arithmetic.	B.B. Reading.	PLAYTIME.	Kindergarten.	Drill.	GRACE AND DISMISSAL.	MONDAY.	Drawing.		PLAYTIME.	Recitation.	Writing.	PRAYERS AND DISMISSAL.
I.	,,	Reading.		,,	,,						,,	,,	
II.	,,	,,		,,	,,						,,	,,	
III.	,,	,,		,,	,,						,,	,,	
Stand.	,,	,,		,,	,,						,,	,,	
Babies.	Arithmetic.	Writing.		Object Lesson.	Singing.		TUESDAY.	Girls—Needlework. Boys—Kindergarten (various).			Reading.	Tables.	
I.	,,	,,		,,	,,						,,	,,	
II.	,,	,,		,,	,,						,,	,,	
III.	,,	,,		,,	,,						,,	,,	
Stand.	,,	,,		,,	,,						,,	,,	
Babies.	Arithmetic.	Writing.		Kindergarten.	Singing.		WEDNESDAY.	2.10–2.40. Reading.	2.40–3.10. Games.		Recitation.	Writing.	
I.	,,	,,		,,	,,			,,	,,		,,	,,	
II.	,,	,,		,,	,,			,,	,,		,,	,,	
III.	,,	,,		,,	,,			,,	,,		,,	,,	
Stand.	,,	,,		,,	,,			,,	,,		,,	,,	
Babies.	Arithmetic.	Writing.		Oral Compos.	Singing.		THURSDAY.	Drawing.			Reading.	Tables.	
I.	,,	,,		,,	,,						,,	,,	
II.	,,	,,		,,	,,						,,	,,	
III.	,,	,,		,,	,,						,,	,,	
Stand.	,,	,,		,,	,,						,,	,,	
Babies.	Arithmetic.	Reading.		Object Lesson.	Drill.		FRIDAY.	Girls—Needlework. Boys—Kindergarten (various).			Drawing.	Story or Fairy Tale.	
I.	,,	,,		,,	,,						,,	,,	
II.	,,	Clay Modelling.		,,	,,						,,	,,	
III.	,,	,,		,,	,,						,,	,,	
Stand.	,,	,,		,,	,,						,,	,,	

Accommodation, 620.

There are ten classes, each taught by a certificated teacher. There are, in addition, five pupil teachers. These teach during the mornings of one week and the afternoons of another. When not engaged in teaching, they take private study in the assistant-teachers' private room. Once a week a criticism lesson is held. All classes but the one required are dismissed twenty minutes before the usual time. All the pupil teachers stay for the lesson, and the assistants stay, two at a time, by arrangement. The criticism is conducted invariably by the head-mistress.

Morning school commences at 9, afternoon at 2.

From 9 to 10 early marks are recorded, prayers and religious instruction and closing registers occupy the remainder of the hour.

From 2 to 2.10, grace, early marks, and registers closed.

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lessons will show how far this system is capable of being carried out.

NATURE DRAWING (BRUSH)—EIGHTH MONTH.

Object Lessons.

BABIES.—(*a*) A tree, a flower, a nut, an acorn, an apple, a pear, an orange, a peapod, grass, wheat, barley. (*b*) A pin, boots, glass, a clock, a book, paper, a newspaper, a lead pencil, a pen. (*c*) *Girls*—Dolly, dolly's house, how to nurse dolly, how to dress dolly; things in the kitchen, bedroom, and the classroom; how to set dolly's tea-things on the table; things we eat with, things we drink with. (*d*) *Boys*—Kindness to pets: the cat, the dog, the rabbit, the squirrel, the canary, and the goldfish; how to make a kite; honey, sugar.

MIDDLE DIVISION: Ages, 4 and 5.—(*a*) Roots of plants, stems, leaves, blossoms, and seeds; wheat, barley, and oats; the daisy, buttercup, sunflower, the rose. (*b*) A sponge, silk and silkworm, butter, salt, a comb, a chair, a house and its parts; the fire, how to make it; dangers of playing with fire; the lamp and its dangers. (*c*) A picture, almanac; examination of photographs through a stereoscope. (*d*) The postman, the milkman, and the railway station.

SENIOR DIVISION: Ages, 6 and 7.—(*a*) Nature study in season: *Spring*—Bursting of the leaf-bud, the flower-bud; examination of flowers—the daffodil, the daisy, and buttercup. *Summer*—Study of the birds: the thrush, blackbird, swallows, the swan, owl, and the hawk. *Autumn*—The changing leaf, the fall of the leaf, the house-creepers, the nut and the acorn; autumn flowers, the chrysanthemum. *Winter*—Snow, ice, hoarfrost; the sleeping plants and trees; sliding and skating, snowballing; other winter sports. (*b*) *Miscellaneous*—A coal mine and the dangers of the miner, a piece of coal; the coins we use—what they are made of, and their value; a set of garden tools; the rainbow, the clouds, fog and mist; the tiny raindrop.

Towards the close of the afternoon the vicar came in to see the teachers for the first time since before the holidays. He was a welcome visitor, and had a pleasant smile for the children and a cheery greeting for the teachers. He conducted the closing prayers of the children, which concluded by the Lord's Prayer being said in a very soft and gentle whisper—so softly, indeed, that a child could hardly hear the voice of the one who knelt next to him. This was very impressive indeed, and must have a beneficial effect on the children. It came as near to real devotion as is possible.

The time table of the school is given above.

"HOW TO WORK THE EDUCATION ACT."—Dr. Macnamara, M.P., and Mr. Marshall Jackman, chairman of the Parliamentary Committee of the National Union of Teachers, are preparing, and will immediately issue under the auspices of the National Union of Teachers, a work designed to assist members of Local Authorities in carrying out the new Education Act. This work, which will be issued at a shilling from the offices of the National Union of Teachers, 67 Russell Square, London, W.C., will give a detailed and exhaustive account of the powers and duties of the new Local Authorities under the Act, and the official effects of its operation in every part of the country. Practical hints as to the staffing of schools, the question of school managers and their duties, scales of salaries for teachers, the question of the condition of the fabric of the buildings, etc., will all be dealt with with the view to rendering practical assistance to those who will have to administer the Act.

OUR French contemporary, the *Manuel General*, has recently given the views of eminent authorities on the vexed question whether history should be studied backwards or not—that is, whether contemporary history should be taught first. D'Alembert is credited with being the first to propose that history teaching should begin with the present, and he is supported by Charles Mismer, the positivist philosopher. Voltaire expresses a strong preference for the other method, and Edgar Quinet, after a careful piece of reasoning, concludes that we ought to deal with causes before effects.

DRAWING IN SAND.

FOR THE BABIES AND YOUNG INFANTS.

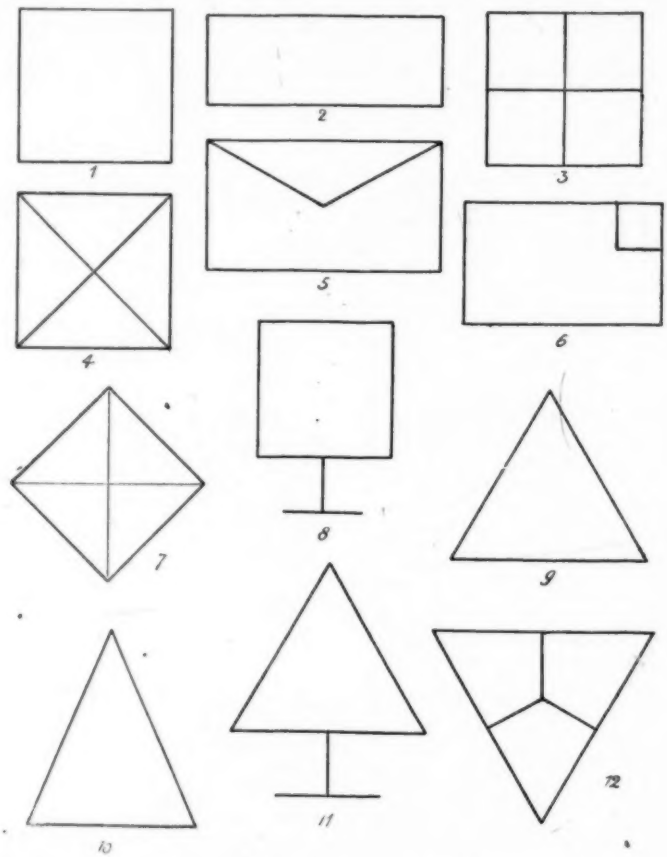
BY CHARLES F. HAYWARD,
Somerville Road Schools, Birmingham.

LONG before English schools were established, or even dreamt of, little children learned their lessons 'neath the clear blue sky. Slates they had not, nor had they paper, ink, and pen. They wrote in the sand with finger-tip. Sand there was plentiful enough. It lay at their feet. It was irksome to the tread, but exceedingly convenient for the purpose of writing in.

We find no trace of the use of sand in our own schools until quite recently. Those who introduced it—and it is a disputed point as to who they were—did a magnificent service to little children. Instead of the dirty, filthy slate, with its many objectionable ways of cleaning, with the numerous ways of spreading infection, and causing undesirable habits to be formed among the children, they can now use a clean, a healthy, and an altogether suitable writing material—sand. For the purpose of writing and drawing in it is splendid, and the apparatus wanted is very little.

The sand itself is very fine. It is called commercially *Calais sand*, and can be obtained from most of the firms which supply ordinary school materials. It is sold in bags of 7 lbs., 14 lbs., 28 lbs., half cwt., and a cwt. The cost is variable, but very little. A bag of 14 lbs. will well supply a class of fifty or sixty children, and, if it be taken care of, it will last a very long time. From its very nature it is perfectly clear that sand cannot be used on the open desk with anything approaching success. It must be contained in something which will prevent it from being strewn on the floor, blown about, or lost. The most convenient way of using it is in trays—sand trays, as they are called. These can now easily be obtained ready made, or, if any difficulty in procuring them be found, they can be made by a carpenter, even if he has never seen or heard of one before. Trays that can be purchased are of two shapes and sizes—square and oblong. Square ones are best for use in the baby-room, and oblong ones for older children. The square ones are generally 10″ by 10″, and a good and convenient size for oblong-shaped trays is 12½″ by 10″. Deal is the wood employed; it is white and clean-looking, and can be washed with soap and water and be made to look quite new. Round the edges of a flat board of the size mentioned a ledge is fixed by means of tiny sprigs. It is best not to use glue, for if hot water be used for washing, the glue may soften and the ledges come away. The depth of the ledge is generally 1½″. So much for the trays.

If a little sand be poured into the tray, it can readily be scattered thinly over the floor of the tray by gently shaking it from side to side. A little practice in this soon enables the children to procure a perfectly even surface over the whole floor of the tray. The thinner it can be layered the better.



For writing purposes, the first finger of the right hand may be used, especially with the babies in the earlier stages, or a slate pencil may be used either blunt or sharpened. But for drawing, something finer is better. A good tool is a strong steel knitting-pin. With this a splendid fine (comparatively) line can be made.

While at work the trays must be kept perfectly flat on the desk.

The first things to teach are—top, bottom, left, and right sides, the teacher always referring to them in this order. The next—top left corner, top right, bottom left, and bottom

right. Although not absolutely necessary, it is a good thing to teach the middle of the sides. Some trays are marked with a black spot on the ledge in the middle of the sides; but this plan affords the children a crutch, and crutches in teaching are best avoided.

The easiest exercise, and the one usually taken first, is drawing a line from top middle to bottom middle, the hand being kept well out of the way of the sand. When this can be done, let the children try a line from left middle to right middle, the two lines crossing, if they be accurate, in the centre of the tray. The teacher who adopts this system of drawing must *not* be discouraged at the children's first attempts. Very funny lines are drawn by the tiny hands first of all. After a few lessons, it is astonishing to see how nice they look.

A good second exercise is to draw three lines from top to bottom, the first being as before from top middle to bottom middle, the second from a point midway between top middle and top left-hand corner to a similar point under it at the bottom, and the third from a point midway between top middle and top right-hand corner to the corresponding point at the bottom. To extend this exercise, have lines drawn from left side to right side from similar points. Little children like names for their drawings, and these two exercises may be called windows, the first containing four panes and the second sixteen.

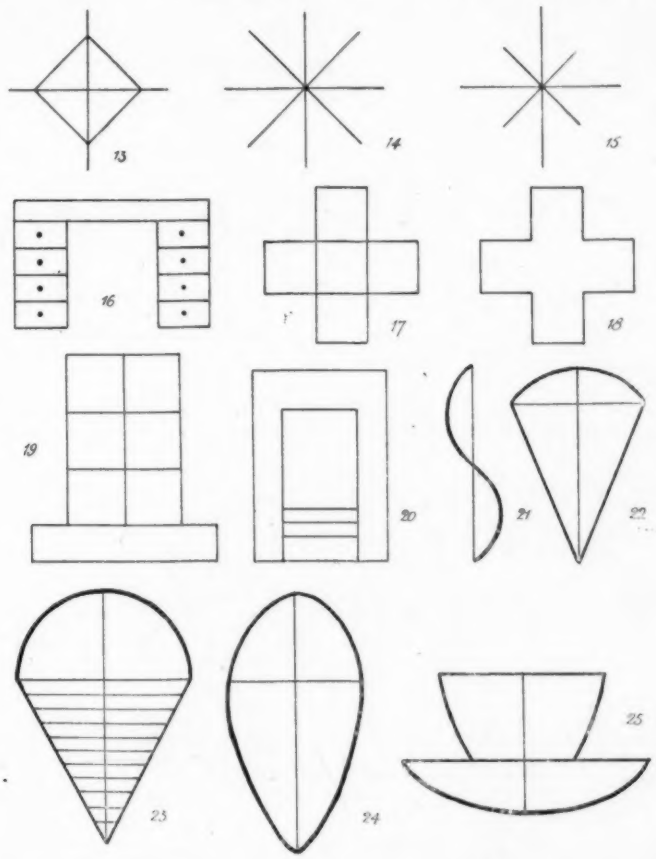
Easy exercises of this kind will readily suggest themselves to the teacher.

When some facility has been acquired in drawing lines from ledge to ledge, the children must practise lines which terminate on the floor of the tray away from the ledge. Nos. 1, 2, 3, 4, 5, and 6 in the diagrams are suitable exercises for this purpose. They may be varied in several ways. Before going on to the harder copies, it is a good thing for the children to practise drawing the printed letters of the alphabet which lend themselves to this stage. The letters are, E, F, H, I, L, and T. H may be called a stile, and T a table. Now Nos. 7 and 8 may be attempted, and the letters K, M, N, V, W, X, Y, and Z used as further exercises. M may be called a swing, N a gate, and so on. With the exception, perhaps, of letters B, C, D, G, J, O, P, Q, R, and U, these exercises will be found to be sufficient for the babies. The others in the diagram are more suitable for children in the higher class.

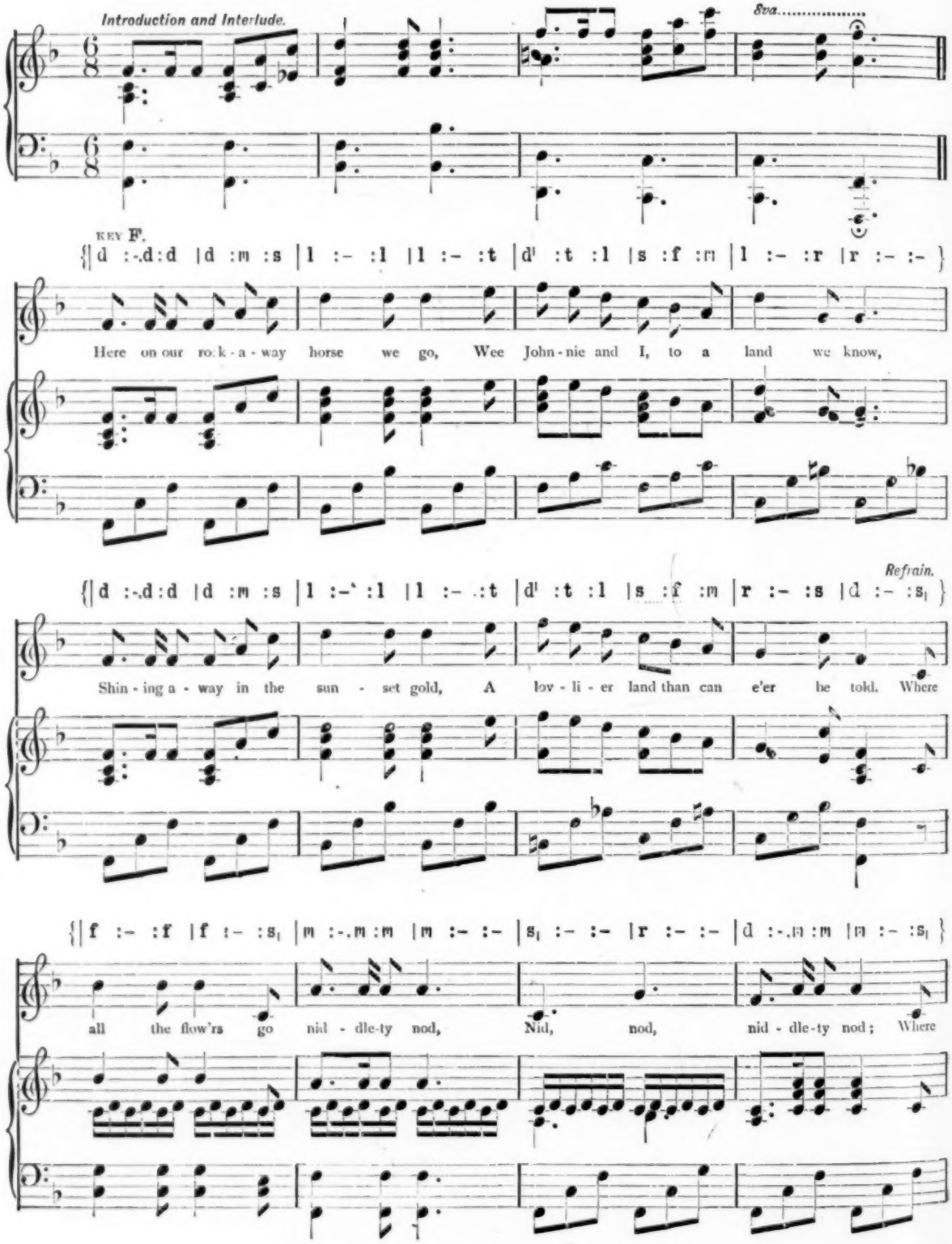
There is no need to keep the babies to the sand alone. They will delight in repeating the exercises on paper. When using lead pencils, the points should not be too fine, a blunt point and a wide line *stroked* on to the paper being far preferable to a hard, thin line that looks as though it were trying to find its way through the paper to the other side.

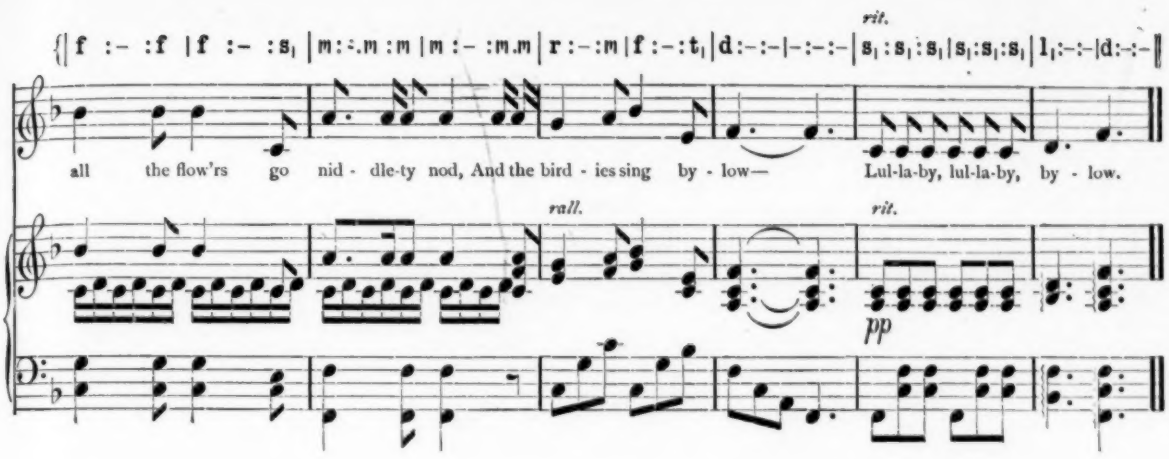
From the nature of the sand it is evident that rulers cannot be used. The diagrams, however, may be used as exercises in ruling for older children.

There is no need to collect the sand from the trays at the end of the lesson. When stored in the cupboard one on top of each other, the ledges prevent the sand from being interfered with. In this way the trays are always in readiness for use.



THE EDUCATIONAL AUTHORITY FOR LONDON.—Mr. Balfour has received a memorial signed by a majority of the Senate of London University expressing the opinion that the authority for London should be similar in constitution to those established in the rest of the country, and should be a committee of the London County Council and of other persons representing different educational interests in London. The County Council members would be in touch with the ratepayers, and the others might be expected to supply the expert advice.

A LULLABY SONG.

Introduction and Interlude.
8va.....
KEY F.
{| d :-.d:d |d :m :s |l :- :l |l :- :t |d' :t :l |s :f :m |l :- :r |r :- :- }
Here on our ro:k - a - way horse we go, Wee John - nie and I, to a land we know,
Refrain.
{| d :-.d:d |d :m :s |l :-' :l |l :- .:t |d' :t :l |s :f :m |r :- :s |d :- :s, }
Shin - ing a - way in the sun - set gold, A lov - li - er land than can e'er be told. Where
{| f :- :f |f :- :s, |m :-.m :m |m :- :- |s, :- :- |r :- :- |d :-.m :m |m :- :s, }
all the flow'rs go nid - dle-ty nod, Nid, nod, nid - dle-ty nod; Where



1 HERE on our rock-away horse we go,
Wee Johnnie and I, to a land we know,
Shining away in the sunset gold,
A lovelier land than can e'er be told.
Refrain.—Where all the flow'rs go niddlety nod,
Nid, nod, niddlety nod;
Where all the flow'rs go niddlety nod,
And the birdies sing bylow—
Lullaby, lullaby, bylow.

2 Ivory gates are all set with pearls—
There's one for the boys, and there's one for girls;
Fasten your two bonnie eyes of blue,
Or maybe the fairies won't let you through.—*Refrain.*

3 Each little slumbering golden head
Is pillowed so soft on a satin bed;
Cosy we lie among sheets of silk,
As soft as the down, and as white as milk.—*Refrain.*

4 Sleepy wee brooklets go babbling by,
The little white clouds are asleep in the sky;
Dear little Johnnie is sleeping too,
So open your gates and let him through.—*Refrain.*

ACTIONS.

Verse 1.—*Fingers enlaced, and the hands swing cradle-ways in front; point outwards, then upwards, and finish with a sweep of both hands. Refrain: Nod heads to sides and to front; imitate flight of birds; fold hands on breast at lullaby, or give cradle motion again.*

Verse 2.—*Point with both hands, first right and then left hand; hands on eyes; then show a warning forefinger.*

Verse 3.—*All sit and pretend to have gone to sleep, pillowing the head on one arm, and "tucking in the sheets" with free hand. Refrain, brisk as before.*

Verse 4.—*Indicate the brooks and the clouds; pretend to be asleep again; wide sweep of the hands to show the opening of the gates.*

Refrain may be very softly done, or first time p, last time pp. The lullaby should be sung pp each time. This song is not difficult, is very effective, and worthy of some trouble being spent over it.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

NEW SCHOLARSHIP COURSE FOR 1903.

Third Month—March.

(*N.B.*—**I should be glad if students who intend to follow this course regularly would send their names and addresses to me.**)

Work for the Month.

1. *Reading.*—Oral practice is an essential to success. For special preparation, *The Heroes:* The Argonauts, Parts 5 and 6.

2. *Repetition.*—Learn 10 to 20 lines each week till the whole of the selected passage is known.

3. *Teaching.*—Chap. iii., *Scholarship School Management:* Teaching Aids.

This chapter requires careful preparation, since there is no lesson given in school in which one or other of these "Aids" is not used. The proper use of the blackboard is always a mark of the clever teacher. There is also much for the young teacher to learn in the manner of utilising a picture, a diagram, a map, etc. In all elementary science lessons experiments are absolutely essential. They may be simple—in fact, the simpler the better, provided they are to the point—but they are necessary, not only to create an interest, but also to train the minds of the children. When the experiment is worked, the attention of the class should be directed to the particular point being illustrated; they must be told to observe *exactly* what takes place, and afterwards deductions from what was observed must be made. The teacher should give no explanation till the children have shown that they cannot grasp the fact being taught; it may be necessary to work the same experiment several times before the difficulty is cleared, but the final solution must come from the class. The experiment is a puzzle set, and the answer must not be supplied till every one has tried in vain.

4. *Drawing.*—One or two copies each week. Send up occasionally for criticism.

The specimens submitted to me this month exhibited the following faults, which must be guarded against:—(*a*) The drawing is too small. The requirement is to fairly fill a half imperial sheet—that is, 15" × 22". A drawing about 6" × 4" is evidently useless. (*b*) Many students find a difficulty in lining in with a brush. The lines are too thick, and are very uneven. I think this is largely due to the use of an unsuitable brush. A *sable* brush, rather fine, is the best to use. They are more expensive than others, but are well worth the extra outlay. With such a brush the finest lines may be obtained, and with a brush an infinitely greater amount of expression can be given.

All students are advised to practise occasionally from nature. Take a spray of leaves, a simple flower, etc., study the shape, note the characteristic edging of the leaves, and reproduce on paper. General directions are not half so useful as criticism of actual drawings, therefore submit specimens.

5. *Music.*—Diatonic and chromatic intervals.

More mistakes are made over intervals than any other topic in music, whereas ten minutes' careful study should make the whole quite clear.

Diatonic intervals are such as occur between any two notes of the major scale.

An analysis of these will show that there are *two* kinds of each, and if all be taken and tabulated the results will be—

Seconds contain	1 Semitone	...	Minor Second.
	or 2 Semitones	...	Major ,,
Thirds ,,	3 ,,	...	Minor Third.
	or 4 ,,	...	Major ,,
Fourths contain	5 Semitones	...	Perfect Fourth.
	or 6 ,,	...	Pluperfect or Tritone Fourth.
Fifths ,,	6 ,,	...	Imperfect Fifth.
	or 7 ,,	...	Perfect ,,
Sixths ,,	8 ,,	...	Minor Sixth.
	or 9 ,,	...	Major ,,
Sevenths ,,	10 ,,	...	Minor Seventh.
	or 11 ,,	...	Major ,,
Octave ,,	12 ,,		

Note.—There is only *one* tritone fourth in the scale, **f–t**, and only *one* imperfect fifth, **t–f**. Chromatic intervals contain either *more* semitones than the corresponding diatonic, when they are called augmented, or *fewer*, when they are called diminished.

To take examples: What interval is **r–t**? Counting the notes (including both), it is a sixth. Counting the semitones, we have 9. Then by the table it is a major diatonic sixth. Again, what is **ma–de**? Counting the notes (that is, **m–d**), it is a third. Counting the semitones, it contains 2. As it contains fewer semitones than the minor third, it is a *diminished* third.

6. *Penmanship.*—Ten minutes' practice daily in the *Practical Teacher Copy Book*, and care at all times.

7. *Composition.*—Write one or two essays each week on such subjects as—

(*a*) Holidays: their necessity and their uses.
(*b*) The English Parliament.
(*c*) "Words are like leaves, and when they most abound
Much sense of fruit beneath is rarely found."
(*d*) "Hope springs eternal in the human breast."
(*e*) The Japanese.
(*f*) How far is it true that history is the biographies of great men?
(*g*) "The darkest day,
Wait till to-morrow, will have passed away."

Read up the subject, if necessary. Draw out a skeleton plan, and express your ideas in as clear and forcible language as you can.

In dealing with a subject like (*c*), first explain the literal truth; where the vigour and sustenance of a tree are utilised in making new wood and leaves, it cannot bear much fruit; hence the necessity in many cases for vigorous pruning. Then apply the simile to man. Words—that is, undue talkativeness—are rarely accompanied by much deep thought. The thoughtful man is usually reticent; examples of this are easily found in history, or among your personal acquaintances. Explain and illustrate this fully.

Above all, let your composition be your very best and most careful thought.

8. *English.*—(1.) Learn twenty-five roots and meanings each week.

(2.) Prepare thoroughly the grammar and syntax of the pronoun, noting particularly classification.

(3.) *The Task*, Book V., lines 85–126. Full notes on this have appeared in these columns, but students must write if they experience any difficulty in meaning, parsing, analysis, etc.

(4.) *As You Like It*, Act I., Scene iii., and Act II., Scene i.

(5.) The fusion of Anglo-Saxon and Norman-French, up to Chaucer.

Notes.

On the Pronoun.

(*a*) Note the difference between *ye* and *you*. *Ye* is the old nominative, now rarely used; *you* the objective. *You* is plural, although used in addressing *one* person.

(*b*) *What* is never used after an antecedent. It is generally considered as a compound relative.

(*c*) *But* is a relative equivalent to *who* and *not*—for example, "There is no man here *but* honours you."

(*d*) *As* is a relative pronoun, usually following demonstratives—*such*, *same*, etc.

(*e*) Note clearly the difference between *our* and *ours*, *your* and *yours*, *my* and *mine*, *thy* and *thine*, *her* and *hers*. The first in each case is a personal pronoun, possessive case; the second is a possessive pronoun, and is never possessive case.

(*f*) The indefinite pronouns must be carefully noted.

(*g*) Distinguish also the reflexive from the emphatic pronouns.

The former is the object of the sentence—for example, *He hurt himself;* the latter is used after a personal pronoun—*He himself went away.*

"*As You Like It.*"

Act I., Scene iii.—The sudden passion which Rosalind feels for Orlando, and the loving gentleness and friendship of Celia, are beautifully depicted in the opening of this scene.

Cousin. The duke uses this word in the proper sense of "relative." Lat. *consanguinis* = of the same blood. Nowadays its application is restricted.

If that thou beest. That is superfluous in such phrases, which are common in Shakespeare.

Juno's swans. Should be Venus' swans, which drew her in her boat.

She is too subtle for thee. The duke's reasons for banishing Rosalind are those due to a guilty conscience. He can find no real reason, but her presence is a continual reminder of his injustice.

Now at our sorrows pale, which has faded in brightness like our spirits. It was probably the oncoming of evening.

A kind of umber, a brown colouring-matter—from Umbria in Italy.

Curtle-axe. A mispronunciation of the French *coutelas* (cutlass), a short sword. It has nothing to do with axe.

That do outface it, etc. = that hide their cowardice and inward fears by assuming a bold and martial demeanour.

The proposal to take Touchstone with them is a tribute to his character. They both felt that underlying his assumed folly there was a substratum of solid common sense. His jests might amuse them, but they relied on him for other assistance.

Act II., Scene i.—The duke's philosophy is the result of experience. There is no useless repining and complaining at his fate, but a genuine attempt to make the best of his surroundings.

The penalty of Adam. The meaning is that as Adam was face to face with nature, from which he had to get his living by work, so had the duke and his companions.

Toad, ugly and venomous. The old belief in the venom or poison of the toad is, of course, entirely erroneous. The *precious jewel* may be the bright eye, or the old superstition that there was a jewel in the head.

With forked heads, the arrows or spears used in killing the deer.

To the which place. Which is a demonstrative in this case.

Moralise this spectacle. Note the omission of the preposition —not at all unusual.

Thou makest a testament, etc. = thou art making a will as people do in the world, bequeathing all thy property to that which already has enough.

Thus misery doth part, etc. = it is with thee as with the world—misfortune soon scatters the crowd of so-called friends.

I love to cope him, etc. = I like to encounter him when he is in this mood, for then he is full of good, sound, sensible opinions.

Scene ii.—The duke discovers the flight of Rosalind and Celia, and comes to the conclusion that they have fled in company with Orlando.

Some villains of my court, some of the servants. The meaning of the word *villain* was not then so restricted as it is now.

Sufferance, know of this, and permit it to take place.

A-bed. A in this case is the old preposition equivalent to *in* or *on.*

Roynish, rascally. French, *rogneux,* scurvy, ill-conditioned.

Let not search and inquisition quail, etc. = let there be no scruples about searching for and bringing them back.

The Language.

The period set for study this month is the period of fusion, when the rival languages were gradually becoming one. Some of the chief changes were indicated last month. As well as the loss of inflexions, there was also a considerable modification of pronunciation—for example, the hard *c* and *k* were softened into *ch* (*church* from *kirk*), the guttural *g* became *y*, the article was introduced, and the French plural *es* took the place of the Anglo-Saxon *en.*

There were three dialects in England—the Northern, Midland, and Southern—with many differences in grammar and inflexion. The ending of the verb third person plural was: Northern, They hope*s;* Midland, They hope*n;* Southern, They hope*th.* The Midland, or rather the east Midland, ultimately became predominant; but many traces of these dialects still remain. A Yorkshire miner and a Somerset farm-labourer could hardly understand each other. The Wessex peasant still retains the old Southern dialect, and conjugates his verb, "I be, thou bist, he be, we be, you be, they be." The literature of the period is scant. The chroniclers of the age, such as Joseph of Exeter, Ingulf, Vitalis, William of Malmesbury, Geoffrey of Monmouth, Giraldus Cambrensis, wrote in Latin. The English writers were few—Layamon (*The Brut*), Orm (*Ormulum*), Mandeville (*Travels*), Gower (*Confessio Amantis*), Langland (*Piers Plowman*). It was not till Chaucer that the new language, compounded of both elements, may be said to have had an existence.

9. *Geography.*—(1.) India. Divisions, towns, peoples, and religions.

(2.) Europe. Revise Russia, Austria, Italy, and the Balkan Peninsula.

Notes.—The government of India is different from any other possession. India is not a colony but a dependency, and a special form of government has been devised as the result of long experience of the people and their needs. The following table shows how the Indian Empire is governed:—

At Home.

The Secretary of State for India (Lord George Hamilton), and his council of twelve men who have lived ten years in India, and are not in the British Parliament.

In India.

(1.) The Supreme Government—
- (*a*) The Viceroy (Lord George Curzon).
- (*b*) The Commander-in-chief (Lord Kitchener).
- (*c*) *Five* ordinary members.

In addition to these seven, there are sixteen "additional members for legislative purposes," who are called in when the special advice they are competent to give is needed.

(2.) Local Administration.—British India (excluding native states) is divided into *fourteen* local governments. These are:—
- (*a*) Under governors—Madras and Bombay.
- (*b*) Under lieutenant-governors—Bengal, Agra and Oudh, Punjab, Burmah.
- (*c*) Under chief commissioners—Assam, Central Provinces, Berar, Ajmer-Merwara, Coorg, British Baluchistan, North-west Frontier Province, and The Andamans.

These are again subdivided into districts, of which there are 250, each under a collector-magistrate, or deputy commissioner.

The native states, 650 in number, although only 200 are of any importance, cover an area of 679,000 square miles, and possess a population of 63,000,000. Their rulers are more or less independent, but all owe fealty to the crown. Hyderabad, with an area of 82,698 square miles, population 11,000,000, annual revenue £3,000,000, is the chief.

The imperial revenue is about £76,000,000, derived from land tax, opium, salt, stamps, excise, tributes of native states, post and telegraph office, mint, railways, irrigation works, etc.

The largest cities are Calcutta (1,026 in thousands); Bombay, 776; Madras, 509; Hyderabad, 448; Lucknow, 264; Rangoon, 234; Benares, 209; Delhi, 208; Lahore, 202; Cawnpore, 197; Agra, 188; Ahmedabad, 185; Mandalay, 183; Allahabad, 173; Amritsar, 162; Jeypore, 160; Bangalore, 159; Howrah, 157; Poona, 153.

There are 78 different languages spoken in India.

The oldest inhabitants of India are the Dravidians of the Deccan.

The Aryan Hindus now number four fifths of the population. Successive invasions from the north-west have brought the Marathas, Sikhs, etc.

The chief religions professed are:—Hindu (207,000,000), Mohammedan (62,000,000), Buddhist (10,000,000), Christian (3,000,000). In addition, there are numerous sects and beliefs followed by comparatively few—Parsees, Jains, Confucians, etc.

Europe.—This revision must be very carefully done. Use sketch-maps freely. Pay great attention to towns, imports, exports, and government.

The following questions have been asked:—

(1.) Name in order from source to delta the chief towns in the basin of the Ganges and Jumna, and mention briefly matters of interest connected with any of them—historically, politically, or commercially.

(2.) Name the products of British India, specifying the district noted for each.

(3.) What is the area and population of India? Mention some of the different races found in it. From what parts of India do the Sikhs, Ghoorkas, and Marathas come?

(4.) What do you know of Scinde, Tinnevelly, Simla, Plassey, Delhi, Great Indian Desert?

(5.) What manufactures and exports of India have lately

developed most? What are the chief reasons for the development?

(6.) Explain as concisely as you can how India is governed.

(7.) When and under what circumstances was the Punjab annexed? Mention four towns in it, the rivers on which they stand, and some points of interest in their history.

(8.) How are the revenues of the Government obtained in India? and what great public works are carried out by the Government in that country?

(9.) What are the principal railways of India? Describe a journey by one of them.

(10.) Give some account of our first settlement in India, and of the successive additions to our possessions there.

10. *History.*—Henry the Second to Henry the Third.

Considerable attention should be given to the following points:—

Henry the Second.—(*a*) The extent of his dominions; from whom inherited or how acquired.

(*b*) The dispute with the church over the question of the jurisdiction of the clerical courts.

(*c*) Legal reforms—for example, scutage, justices in eyre, assize of sheriffs, assize of Northampton, etc.

Richard the First.—(*a*) The state of the country in the king's absence on the Crusade.

(*b*) The course of the Third Crusade: read Scott's *Talisman*.

John.—(*a*) His title to the throne.

(*b*) The war in Normandy and the battle of Bouvines.

(*c*) The dispute with the Pope: interdict, excommunication.

(*d*) The Magna Charta: circumstances which gave rise to it, and the chief provisions.

(*e*) The war with the barons.

Henry the Third.—(*a*) Government during minority by justiciars.

(*b*) Personal misrule.

(*c*) The Barons' War: Provisions of Oxford.

(*d*) The Parliament of Simon de Montfort.

The *growth* of Parliament.

(*a*) The Saxon Shire Moot was a model Parliament, because it was composed of representatives of all classes.

(*b*) The Magnum Concilium, consisting of all the tenants in chief. To this, however, the smaller barons soon ceased to attend, or to be expected there. They became the country gentry.

(*c*) In 1213 John summoned a National Assembly, to which the reeve and four representatives from each parish on the royal estates were summoned.

(*d*) In 1254 two knights of the shire were summoned from each county. This was only restoring a privilege they had allowed to lapse.

(*e*) In 1265 De Montfort summoned a Parliament, consisting of great barons and clergy (Magnum Concilium), two knights of the shire, and *two burgesses from the towns*. The latter was a distinct innovation.

(*f*) In 1295 the first model Parliament, because all classes of commoners were to *elect* representatives.

(It would greatly assist me in this subject if students would ask for notes on any point presenting difficulty.)

11. *Arithmetic.*—Revise the metric system, and work Nos. 101-150, Christian and Collar. Work the following paper:—

(1.) Prove the rule for finding the G.C.M. of two numbers.

(2.) Determine the prime factors of 40380 and 5757; hence deduce the G.C.M. and L.C.M. of these numbers.

Ans. 3; 77498220.

(3.) Of what numbers can 36 be the G.C.M. and 1440 the L.C.M.? Explain your method of working.

Ans. 36, 72, 144, 288, 360, 720.

(4.) The G.C.M. of two numbers is 72. One of them contains as well the factors 7 and 3, the other 2 and 5. What is the L.C.M.? Ans. 15120.

(5.) What number divided by 24 leaves 19, by 36 leaves 31, by 48 leaves 43? Ans. 139.

(6.) Explain clearly the following statement:—If a measures b and c, it measures $mb \pm nc$.

(7.) Find the L.C.M. of $1\frac{1}{2}$, $\frac{2}{3}$, $\frac{7}{10}$, $\frac{3}{4}$ of $\frac{2}{5}$, $\frac{5}{6}$ of $\frac{1}{4}$. Ans. $\frac{7}{20}$.

(8.) Three men run round a circular track of 1980 yds. in circumference. The first runs 330 yds. a minute, the second 264 yds., and the third 198 yds.; if they start together, how long will it be before they are together again? Ans. 30 minutes.

12. *Algebra.*—Fractions. Use factors wherever possible in solution.

Work the following:—

(1.) Express $4x^2 - 6yz - (9y^2 + z^2)$, $9y^2 + 4xz - (4x^2 + z^2)$, $z^2 - 12xy - (4x^2 + 9y^2)$ in factors, and hence write down their G.C.M. Ans. $(2x + 3y + z)(2x - 3y - z)(2x + 3y - z)$.

(2.) Prove the rule for finding the G.C.M. of two quantities.

(3.) Find the H.C.F. of $4x^4 - 9x^2 + 6x - 1$, and $6x^3 - 7x^2 + 1$. When of two algebraical expressions the H.C.F. has been found, what is the rule for finding their L.C.M.?

Ans. $(2x^2 - 3x + 1)$.

(4.) Find the G.C.M. of $6x^5 - 9x^4 + 19x^3 - 12x^2 + 19x - 15$, and $4x^4 - 2x^3 + 10x^2 + x + 15$. Ans. $2x^2 - 3x + 5$.

13. *Euclid.*—Revise 21-30, Book I., with six deductions per week.

14. *Elementary Science.*—Energy. Heat and temperature. These are fully explained in the text-book. Any difficult point must be sent up for solution.

15. *General Information.*—One paper per week from one of the books of questions published.

Notes on the January Paper.

1. The causes of migration were not very well explained. "Birds come to us in the summer because it is warmer," is a usual statement; but they come from a warmer place generally. This is therefore no reason. The two chief factors are (*a*) the food supply, and (*b*) to find suitable conditions for breeding.

2. Several candidates are very hazy on the principles on which a steam-engine works. They do not notice the enormous expansive power of steam.

The other questions were well done.

Test Paper on General Information.

The answers to these questions are marked gratis. They should be written on foolscap, on one side only, the coupon of the current number must be enclosed, and a stamped addressed envelope for return.

All papers must be sent to Mr. A. T. Flux, The Bays, Belvedere, Kent.

A prize of One Guinea will be given to the student securing the highest percentage of marks.

1. From what poems are the following lines taken, and who were the authors?

(*a*) "The old order changeth, yielding place to new."
(*b*) "'Twas a famous victory."
(*c*) "Our sleep is but a birth and a forgetting."
(*d*) "Storied windows richly dight,
Casting a dim religious light."
(*e*) "Hope springs eternal in the human breast."
(*f*) "There is a tide in the affairs of men."
(*g*) "We thought her dying when she slept,
And sleeping when she died."

2. Explain dog-days, dog-rose, dog-watch, Isle of Dogs, dog Latin.

3. What do the following abbreviations stand for:—M.I.C.E., G.C.S.I., G.C.B., R.S.O., F.P., H.B.M.?

4. Account for the generation of the tidal wave, and trace its course.

5. What is the difference between rates and taxes, flotsam and jetsam, High Church and Low Church?

6. Place each of the following in an appropriate sentence:—Autonomy, autocrat, decrepitude, alibi, *ad hoc*, apocrypha, idiosyncrasy.

7. Describe the process of smelting iron. What is an iron foundry?

8. In what country is the ruler called Negus, Guicowar, Khedive, Amir, Bey, Pasha?

Test Questions on Last Month's Work.

1. *Penmanship.*—Large Hand.—*Plenipotentiary.*
Small Hand.—*All the world's a stage,*
And all the men and women merely players.

2. Distinguish between induction and deduction. What are the characteristics of good questions?

3. Write an essay on the importance of technical education.

4. Analyse the following, and parse words in italics:—

"Well they eye
The scattered grain, and *thievishly resolved*
To escape the impending famine, often scared
As oft return, a pert voracious *kind*."

5. Point out some of the changes produced in the language by the Norman Conquest.

6. What are the monsoons, and what are their effects upon India?

7. Explain clearly how Germany is governed. How do you account for the rapid advance in its manufactures?

8. In what respects did the feudal system as established by William the First differ from that on the Continent?

9. Say what you can of social life in Norman times.

10. What is "mechanical advantage" and the "principle of work"? What is the best system of pulleys for general use, and why?

PUPIL TEACHERS' COURSE.

For Candidates Examination, 1903.

1. *English.*—Finish the *Ode on Spring.*

General meaning:—VERSE 3.—"The hard-working labourer is resting, and the flock and herds are lying down in the shade of the trees; but the air is full of the sounds of insect life. Some are seeking the nectar in the open flowers, some float lazily in the warm air, and others, darting backward and forward over the water, display the most brilliant colouring."

Youth are. The plural verb is used here because the writer is not regarding them collectively but individually.

To taste and *to float*, infinitives limiting *eager*.

Quick-glancing, adjective qualifying *youth*.

VERSE 4.—"To the thoughtful student of nature there is a great similarity between these insects and mankind. Both are doomed after a short existence to come to the grave, whether they belong to the brilliantly-clad class or to the more humble and unnoticed kind. Life is quickly passed through, fortune smiling on some and frowning on others; accident, misfortune, or old age soon terminates their career."

Busy and *gay*, collective nouns in this case.

But = *only*, adverb modifying *flutter*.

Drest in fortune's varying colours, enlargement of *busy* and *gay*.

VERSE 5.—"In answer to my musings, I think I hear the collective voice of the insect world replying, 'Sad philosopher, we are better off than even thou art. Thou hast no wife to share thy joys, no store laid up for the future, and nothing of personal beauty to show. Thy youth has passed rapidly away, and old age is fast approaching. Thou derivest no pleasure from thy present existence. We, at least, do enjoy ourselves while we have the opportunity.'"

Methinks = (It) thinks me. *Me* is dative, governed by *thinks*. *It* is the impersonal subject understood.

Kind, objective case, governed by *hear*.

Reply, infinitive mood, governed by *hear*.

To display, infinitive mood, limiting *plumage*.

2. *History.*—George the Fourth, William the Fourth, and Victoria.

The chief points to be mastered are:—The Cato Street Conspiracy, the Catholic Emancipation, the Reform Bill (most important), Crimean War, Indian Mutiny, extension of the Empire, and the tremendous progress made during the nineteenth century.

3. *Geography.*—General physical geography of the world, and special revision of the British Isles.

4. *Arithmetic.*—Go very carefully through the theory of the rules as far as your year's work takes you. Be sure you understand the reasons for each step in each rule.

5. *Euclid.*—Props. 33–36, with two deductions per week.

6. *Algebra.*—Harder fractions.

7. *Elementary Science.*—Revise, with the help of the following questions:—

(1.) What is a lever? What is the fulcrum of a lever? Name four or five levers in common use, and say where the fulcrum of each may be.

(2.) A piece of metal weighs 19½ grammes in air and 17½ grammes in water. What is its specific gravity?

(3.) A penny lies at rest on a sloping desk. What forces are acting on it? Draw a diagram showing clearly the direction of each.

(4.) Two boys push against a gate in opposite directions. One boy pushes near the middle, and the other near the end farthest from the hinge. Explain why one boy has an advantage over the other.

(5.) A glass funnel is entirely immersed in water, with its mouth downwards. A finger is placed tightly upon the upper end, and the funnel is gradually raised out of the water. Why will the funnel be found to be full of water? How far can it be raised before the water will run out? What results will be obtained if the finger is not placed upon the funnel until the latter is half out of water?

(6.) A tube of the shape U, with both ends open, is fixed in an upright position. First, we pour in enough mercury to fill the curved part, then we pour 20 cubic centimetres of water into one arm and 50 cubic centimetres of water into the other. Draw a diagram to show the positions which the liquids will take up, and give any explanations you may think needful.

(7.) Two iron bars of equal length and thickness are fastened together (without overlapping) so as to make a figure of the shape T. Where is the centre of gravity of the figure?

(8.) Weights of 18 ounces and 7 ounces are joined by a thread which passes over a fixed pulley. The larger weight rests on a table at a point underneath the pulley; the smaller weight hangs in air. What is the pressure (1) on the table; (2) on the pulley?

(9.) The nets over the heads of the passengers in a railway carriage are piled up with parcels. From which side are the parcels most likely to fall (1) when the train is starting; (2) when it is stopping? How do you explain the result?

(10.) Which way is the lower valve of the common pump made to open? What is the force that sometimes keeps it open? What is the force that sometimes presses it shut?

(11.) Four forces act on a point. The first, of 10 lbs., acts due north; the second, of 15 lbs., due east; the third, of 20 lbs., due south; and the fourth, of 25 lbs., due west. Find the magnitude and direction of the resultant.

(12.) The point of a gimlet with which a hole has been bored is found to be hot. How do you explain this? Give other instances of the same sort.

(13.) Define mass, volume, and density, and state the relation that exists between them. Suppose you were given two irregular pieces of metal, one of which was gold, and the other gilded brass. How would you find out by a physical method which piece was gold?

(14.) Explain why a ship of iron will float in water, though iron itself is heavier, bulk for bulk, than water.

(15.) State the principle of the action of the single movable pulley. How would you show that the strain or tension in a cord supporting a pulley is equal to half the weight hanging from a pulley?

(16.) Energy may be defined as the ability to work. Give instances to show that heat, electricity, and chemical action are forms of energy.

(17.) How would you determine the centre of gravity of an iron hoop made by joining together two semicircles, one thicker than the other? Explain how the observations could be used to find out which was the thicker half of the hoop.

Test Examination.

The questions should be answered in the time allotted, and under examination conditions.

The answers will be marked if sent to Mr. A. T. Flux, The Bays, Belvedere, Kent, with a postal order for two shillings.

ARITHMETIC.

(1 hour. 100 marks. Answer three questions, including the first if you can.)

1. (*a*) Multiply 9879 by 99 the shortest way you can.

(*b*) If you are dividing by factors 7, 9, 8, and the remainders are respectively 6, 5, and 4, what is the whole remainder?

(*c*) What is the least number which may be added to 35916 to make a multiple of 117?

(*d*) A train travels 35 miles an hour. What is that in feet per second?

2. If three hands of a clock which move round once in 18, 19, and 20 hours respectively be placed together, after how many days will they all be together again?

3. A tea dealer mixes 42 lbs. of tea which cost him 2*s.* 1½*d.* per lb. with 12 lbs. at 2*s.* 5½*d.* per lb. At what price per lb. must he sell the mixture in order to realise a profit of £1, 5*s.* 3*d.*?

4. Simplify $\dfrac{4\frac{1}{2}+7\frac{3}{4}}{13\frac{1}{4}-9\frac{3}{4}} \times 1\frac{1}{4}\frac{1}{8} \div \dfrac{2\frac{1}{4}+3\frac{5}{8}}{8\frac{1}{5}-1\frac{3}{10}}$.

An even bar of steel weighs 3 qrs. 15 lbs. 13¾ oz. What part must be cut off to weigh 58 lbs. 4⅝ oz.?

5. A man gives a boy 20 yards start in 100 yards, and loses the race by 10 yards. What would have been a fair start to give?

GEOGRAPHY.

(1 hour. 80 marks. Answer three questions.)

1. Two ships start from Cork. One sails 20° south, the other 20° west. Which goes the farther, and why?

A traveller goes round the world westward. When he returns he finds that he is a day behind the time of the place he started from. How is this?

2. Mention ten of the largest rivers in the world. Why have some of them deltas and some none?

3. Where and what are the following:—The Bog of Allen, the Downs, the Fens, the Potteries, Carse of Gowrie, the Trossachs?

4. What class of goods are imported and exported at Liverpool, Glasgow, Hull, London, Bristol, and Dundee?

5. Say what you can of the following:—Cardiff, Sheffield, Paisley, Galway, Burton, Norwich, Winchester, and Crewe.

HISTORY.

(1 hour. 80 marks. Answer three questions.)

1. What do you know of Stephen Langton, Francis Drake, Robert Walpole, John Hampden?

2. Take the following battles, and make a tabular statement, (*a*) where they were fought; (*b*) between whom; (*c*) the results; (*d*) the date:—Battle of the Standard, Poitiers, Agincourt, Pinkie, Marston Moor, Ramilies, Corunna, Inkerman, Plassey, and Brunanburgh.

3. What causes led to the revolution of 1689?

4. Mention, with dates, six important statutes passed, and give briefly their provisions.

5. Explain concisely how the British Isles were united under one Parliament.

ENGLISH.

(1 hour. 80 marks. Answer Question 1 and two others.)

1. Analyse the following:—

"*No further seek* his merits *to disclose*,
Or draw his frailties from their dread abode
(There they *alike* in trembling hope repose),
The *bosom* of his Father and his God."

2. Parse the words in italics.

3. Define, with illustrations from the poems you have studied:—Passive voice, transitive verb, infinitive mood.

4. Give the meaning and use of the suffixes in the following:—*Freedom, neighbourhood, hireling, wedlock, hatred, sidelong, manifold, gladsome.*

5. Write a short life of Gray. Mention any other of his works you have read.

COMPOSITION.

(½ hour. 50 marks.)

Write an essay on the way to attain success; *or*, Give in your own words the substance of what Gray says about the lot of the villagers.

MUSIC.

(15 minutes. 15 marks. Answer three questions.)

1. Name the following intervals:—

r-t, t_1-f, r-f, f-t, d-d^1.

2. What are the mental effects of r, s, l, t? How are mental effects modified?

3. Rewrite the following, halving the value of every note and rest:—

| d :-.d | r :- | s : | m : | f :r | d :t_1 | d :- | - :- |

ELEMENTARY SCIENCE.

(½ hour. 100 marks. Answer two questions.)

1. A boat is being towed up a river. Is it best to use a long rope or a short rope? Give reasons for your answer, and draw a diagram.

2. A plank 20 feet long and weighing 50 lbs. hangs over the edge of a flat roof. If 12 feet of the plank project, what weight would have to be placed on the other end to prevent its falling?

3. Explain clearly why the earth moves round the sun in a circular course. Why is the term *centrifugal* scientifically incorrect?

4. Describe three experiments to prove that matter is indestructible.

5. What mechanical advantage do you get with (*a*) a single fixed pulley; (*b*) a single movable pulley; (*c*) two blocks of pulleys, four wheels in each?

First and Second Years.

Finish the revision of the year's work in all subjects.

Test Examination.

The following examination should be answered as a test of the year's work. *Some* final examination must be held to satisfy H.M.I. The questions should be answered in the allotted time, and under examination conditions. Pupil teachers who wish to have their papers marked, etc., should send them to Mr. A. T. Flux, The Bays, Belvedere, with a postal order for two shillings.

FIRST YEAR.

ARITHMETIC.

(1 hour. 100 marks. Answer three questions. No. 1 is most highly marked.)

1. Point out the advantages of the metric system, and show what relation the gramme, litre, and are bear to the metre.

An English penny weighs 175 grains, and a French 10 centime piece weighs 10 grammes. How many 10 centime pieces will weigh as much as a sovereign's worth of pennies? (1 gramme = 15·4323 grains.)

2. A sum of £3070, 3s. 3d. has to be divided between A, B, and C, so that A may have ⅓ of ⅔ of B's share, B ⅔ of A's and C's together. Find their shares.

3. A cask which holds 20 gallons is filled with 15 gallons of brandy and 5 of water; 4 gallons of the mixture are drawn off, and the cask is again filled with water. Find the percentage of brandy in the second mixture.

4. A person selling apples at 3 a penny gains 5 per cent. Find the gain or loss per cent. when 25 are sold for 6d.

5. On the 1st January 1896 a man borrowed a sum of money at 5 per cent. simple interest. At the end of the year the rate was reduced to 4½ per cent. The total amount of interest paid up to the end of 1901 was £1760. What was the sum borrowed?

GEOGRAPHY.

(1 hour. 80 marks. Answer three questions.)

1. What do you know of the following:—The Tundras, the Maelstrom, the Steppes, the Morea, the Campagna, the Iron Gate?

2. What do you understand by the term *Germany?* Explain clearly how it is governed, and state very briefly why its manufactures have increased so rapidly of recent years.

3. Give some account of the British possessions in Asia (excluding India).

4. Draw a sketch-map of Asiatic Russia; mark in the chief towns and the courses of the Trans-Siberian and Central Asiatic Railways.

5. Where and what are the following:—Medina, Yokohama, Colombo, Samarcand, Bushire, Smyrna, Kiev, Barcelona, Tours, Bergen?

HISTORY.

(1 hour. 80 marks. Answer three questions.)

1. Say what you can of *two* of the following:—Anselm, Thomas of Lancaster, Wycliffe, Cardinal Beaufort, Protector Somerset, Sir Francis Drake.

2. Write brief notes on Tenchebrai, Sluys, Troyes, Hexham, *Canterbury Tales*, Poynings' Law, and the Star Chamber.

3. Explain clearly the causes which led to the Wars of the Roses. What were their chief results?

4. What was the Reformation? When and how was it carried out in England?

5. Why were the English successful in the French war under Edward the Fourth, and unsuccessful under Henry the Sixth?

ENGLISH.

(1 hour. 80 marks. Answer Question 1 and two others.)

1. Paraphrase one of the following passages:—

(*a*) "When man was multiplied and spread abroad
In tribes and clans, and had begun to call
These meadows and that range of hills *his own*,
The tasted sweets of property begat
Desire of *more*; and industry in some
To improve and *cultivate* their just demesne
Made others covet what they saw *so fair*.
Thus war began on earth; these fought for spoil,
And those in self-defence."

(*b*) "Know, then, that heavenly wisdom on this ball
Creates, gives birth to, guides, consummates all;
That while laborious and quick-thoughted man
Snuffs up the praise *of* what he seems *to plan*,
He first conceives, then perfects his design
As a mere *instrument* in hands divine.
Blind to the working of that secret power
That balances the ways of every hour,
The busy trifler dreams *himself alone*,
Frames many a purpose—and God works *His own*."

2. Analyse (*a*) as far as "more," *or* (*b*) the first six lines; and parse the words in italics in the piece selected.

3. Give the derivation of the following words:—*Conducted, successive, impeded, deified, transcript, difference, fortitude, invented, terraqueous, impotence.*

4. Explain the metre of the poem you have studied. Quote four lines, and mark the scansion.

5. Define, with examples:—Reflexive pronoun, nominative absolute, extension of the predicate, cognate object.

COMPOSITION.

(½ hour. 50 marks.)

Write an essay on the state of England when Cowper wrote "The Expostulation," *or*, Cowper's ideas of the origin and character of kingship.

MATHEMATICS.

(1 hour. 100 marks. Answer two questions in each section.)

A.

1. Define parallel straight lines, axiom, postulate, corollary, hypothesis, and give examples of converse propositions.

2. If one side of a triangle be produced, the exterior angle is greater than either of the two interior and opposite angles.

3. The perpendicular is the shortest straight line which can be drawn from a given point to a given straight line; and of others, those which are nearer the perpendicular are shorter than those more remote.

B.

1. If $a = 0$, $b = 1$, $c = 3$, $d = -2$, $e = 2$, find the value of $\sqrt{(a-d)^2 + (c-e)^2 - d(c-b)}$.

Simplify $5x - [4y - \{3z + 2x - (y - z)\}] - \{6x - 3(2y - z)\}$.

2. Divide $b^3 + c^3 - a^3 + 2a^2b + 2a^2c - 2ab^2 - 2ac^2 - abc$ by $b + c - a$.

3. Solve $\cdot 75x - \cdot 375 + 2 = x - \cdot 25 + \cdot 125x$.

At present A's age is $\frac{3}{4}$ of B's; eight years ago it was $\frac{2}{3}$. Find their ages.

Music.

(15 minutes. 15 marks. Answer all questions.)

1. Write the following without change of key:—

d s n d s ˢd t, d r n r d t, d ˢs f n r d.

2. Write the following in six-pulse measure:—

|s :s,f,n|f :-,s,f|n,-,r : d, t,|d :- ‖

3. Name the intervals **n–fe, s–ta, r–ta, t–fe.**

Elementary Science.

(½ hour. 100 marks. Answer two questions.)

1. Describe exactly the construction of an ordinary thermometer. What is 77° F. equivalent to in Centigrade and Reaumur?

2. One pound of water at 100° C. is mixed with a pound of water at 0°, and another pound of water at 100° C. is mixed with a pound of ice at 0°. What would the resulting temperature be in each case? Explain the results.

3. How can you prove, analytically and synthetically, that white light consists of various colours?

4. A Union Jack is looked at through red, blue, and yellow glasses. How do its colours appear in each case?

5. Explain the phenomenon of refraction. What is total reflection?

Second Year.

Arithmetic.

(1 hour. 100 marks. Answer three questions. No. 1 is more highly marked than the others.)

1. (*a*) Distinguish between $\frac{1}{3}$ per cent. and $\frac{1}{3}$.

(*b*) A money lender received £1, 6s. 8d. at the year's end for money lent at 33⅓ per cent. The payment cleared off the debt. How much had been lent?

(*c*) Find the profit per cent. of a gold dealer who buys gold at so much a pound weight avoirdupois, and sells at the same rate per pound troy. (7,000 grains troy = 1 lb. avoirdupois.)

2. A rectangular field, which is twice as long as it is wide, costs 1·0138s. per sq. yard to turf. If the whole cost is £191, 17s. 0½d., find the dimensions of the field.

3. Find the value, on 1st March, of the expectation of the sum of £3724, 10s. 5d., due 30th Nov. the same year (allowing 3 days of grace), the rate of interest being 5 per cent.

4. At what price must I buy 4 per cent. stock with the proceeds of the sale of £9600 3 per cent. stock at 86⅜, in order to make no change in my income, allowing ¼ per cent. brokerage on each transaction?

5. A room is half as high and twice as long as it is wide. If the floor contains 1152 sq. ft., what is the cost of papering the walls at 9d. per sq. yd.?

Geography.

(1 hour. 80 marks. Answer three questions.)

1. Say what you can of the West African possessions. Illustrate your answer by a sketch-map.

2. Give a full account of Madagascar, Jamaica, or Tasmania.

3. "Canada is a country of unbounded natural wealth." Comment on this statement.

4. Which of the United States border on the Pacific? What are the productions and chief towns of the Pacific Slope?

5. Where and what are Blantyre, Hobart, Galveston, Toronto, Pernambuco, Cotopaxi, Titicaca, Utah, Stanley Falls?

History.

(1 hour. 80 marks. Answer three questions.)

1. Give the dates, circumstances, and results of the following naval battles:—La Hogue, the Nile, Quiberon, Trafalgar.

2. Explain what is meant by the South Sea Bubble, the Gordon Riots, the United Irishmen.

3. What were the abuses corrected by the Reform Bill of 1832?

4. What did Great Britain gain by the Peace of Utrecht (1713) and by the Peace of Paris (1763)?

5. Why did the American colonies rebel? Why was their rebellion successful?

Composition.

(½ hour. 50 marks.)

Write an essay on Milton's views as to predestination, *or*, Write an account of Milton's works (not his life).

English.

(1 hour. 80 marks. Answer three questions.)

1. Paraphrase the following:—

"So spake the false dissembler unperceived;
For *neither* man nor angel can discern
Hypocrisy (the only evil that walks
Invisible, *except* to God alone,
By His permissive will, through heaven and earth;
And oft, though Wisdom *wake*, Suspicion sleeps
At Wisdom's gate, and to Simplicity
Resigns her charge, while Goodness thinks no ill
Where no ill seems), which now *for once* beguiled
Uriel, *though* regent of the sun, and held
The sharpest-sighted spirit of all in heaven."

2. Analyse from "hypocrisy" to "Uriel," and parse words in italics.

3. Explain the following:—*Ambrosial fragrance, my umpire Conscience, eremites and friars, volatile Hermes, drained through a limbeck, her countenance triform.*

4. What changes did the Norman-French Conquest produce in the language?

5. Correct the following, and explain the reason for your alterations:—

He enjoyed the universal esteem of all men.
Whom did you say called this afternoon?
Go with mean people and we think the world mean.
No place is so much visited or widely known than this cave.
Great pains were taken to preserve secrecy.
The largest circulation of any paper.
A man may smoke and drink till he is unable to live without them.

Mathematics.

(1 hour. 100 marks. Answer two questions in each section.)

A.

1. If one side of a triangle be produced, the exterior angle is equal to the two interior and opposite angles, and the three interior angles of every triangle are equal to two right angles.

2. PQ, PR, the equal sides of an isosceles triangle PQR, are produced to S and T, so that PS, PT are equal. RS, QT intersect in M. If the angle SQT is equal to the angle PQR, then the angle SMQ is equal to twice the angle QPR.

3. To describe a square on a given finite straight line. Find a point in the diagonal produced of a square from which, if a line be drawn parallel to any side of the square, meeting another side produced, it will form, with the produced diagonal and produced side, a triangle equal to the given square.

B.

1. Find the G.C.M. of $x^4 - 3x^3 - 2x^2 + 12x - 8$ and $x^3 - 7x + 6$, and the L.C.M. of $12x^2 - 5x - 2$, $12x^2 - x - 1$, $9x^2 - 9x + 2$.

2. Solve—

(*a*) $x^2 - \frac{8x}{3} = 1$. (*b*) $\frac{x+2}{x-1} - \frac{4-x}{2x} = 2\frac{1}{2}$.

3. Find two numbers such that their sum is 14, and the difference of their squares is 56.

Music.

(15 minutes. 15 marks. Answer all questions.)

1. Write the minor scale in three forms, and explain them.

2. Which of the following is highest in pitch and which is lowest:—**f,** in key C; **r** in key A; **m,** in key B♭; **t** in key G; **s** in key F; **f,** in key E♭?

3. Explain briefly the following terms:—Rallentando, poco mosso, meno mosso, leggiero, maestoso, allegretto.

Elementary Science.

(½ hour. 50 marks. Answer two questions.)

1. What is the difference between a chemical compound and a mechanical mixture? Give examples of each.

2. How would you prepare hydrogen, and what experiments would you work to show its properties to a class? (Sketch your apparatus.)

3. If carbon dioxide is passed through lime water, the latter becomes milky at first and then clear. Explain exactly what takes place.

4. A bar magnet is lying on a table. Explain the action of a small horizontal needle as it is moved in a circle round the magnet. Draw diagrams.

Revision Questions in Science from Government Papers.

First Year—

1. On a cold morning ice is found on the inside of the windows of a room. How is the fact to be explained? Why is not the ice found also on the walls?

2. A thermometer stands in a test-tube containing hot water. A second thermometer is taken out of a vessel of melting ice in which it has been standing, and is placed in the test-tube beside the other thermometer. What will be the behaviour of the two thermometers? How do you explain the results described?

3. A thermometer is placed in the steam arising from a boiling kettle. What temperature will it probably indicate? In what circumstances may steam be obtained (1) at a temperature lower, (2) at a temperature higher than the temperature mentioned in the first part of your answer?

4. An electric lamp which is fixed under water sends out its rays in all directions. Draw a diagram to show (1) the paths of those rays that emerge from the water; (2) the paths of those rays that reach the surface, but do not emerge from the water.

5. Place a prism—say, a drop from a glass chandelier—close to your eye when inside a room, and look through the prism at a window. What phenomena may be observed? How do you explain these phenomena?

6. A bright metal vessel filled with ice is brought into a hot room. What result, besides the melting of the ice, will be observed? How do you explain the result in question?

7. One jar contains a pound of ice, and another a pound of ice-cold water. A pound of water at a temperature of 90° Centigrade is poured into each jar. What will be the temperature of each mixture? How do you account for the difference between the two results?

8. An empty barometer tube which has been standing in a room at a temperature of 15° Centigrade is totally immersed in water at a temperature of 30° Centigrade. After a time ice is added to the water, until its temperature is reduced to 0° Centigrade. Describe the change in volume which the air in the tube will undergo. The open end of the tube is always kept lower than the closed end.

9. A beam of light falls obliquely upon the surface of water. Draw a diagram to show the course of the reflected ray. What can you say about the brightness of the reflected ray (1) when the beam of light falls nearly perpendicularly upon the surface of the water; (2) when it falls very obliquely?

10. Two things happen to a beam of sunlight when it is passed through a prism. What are they? What result is obtained if the sunlight, before reaching the prism, has to pass through a piece of red glass?

11. A candle is placed close to a looking-glass, and its reflection in the glass is viewed a little from one side. What will be seen? As far as you can, explain the appearances which you describe.

12. An upright post is fixed in the bottom of a pond which is three feet deep; the top of the post is three feet above the water. How will the post appear to an eye about the level of the top of the post and four or five feet away from it? Draw a figure to illustrate your answer. What will be seen as the eye moves farther and farther back from the post?

13. It is sometimes said that "red glass colours the sunlight red," and that "blue glass colours the sunlight blue." Mention facts or experiments which show that this is not accurate, and put the statement in more accurate form.

14. What do we mean by the boiling point of a liquid? Explain why good tea cannot be made at the top of a very high mountain.

15. Mention conditions that should be satisfied by the bulb and tube of a mercury thermometer. Give the reason for each condition that you state.

16. Water sometimes spurts from the spout of a kettle standing on a fire. How do you account for this, and how would you prevent it without taking the kettle off the fire?

17. Four ounces of hot lead filings and four ounces of water at the same temperature are poured upon separate slabs of ice. Which melts most ice, and why?

18. How can it be proved that (1) white light is a mixture of many colours; (2) different colours have different degrees of refrangibility?

Second Year—

1. What are the bubbles that appear when a bottle of soda water is opened? Why do they appear upon the opening of the bottle?

2. A glass funnel is placed mouth downwards over an ordinary gas burner, on which it does not fit closely. The gas is turned on, and a lighted match is put to the top of the funnel. How and why does the flame which is produced differ from the flame of an ordinary gas jet?

3. A lesson on mercury has to be given to scholars whose average age is about twelve years. To what properties of the metal should the attention of the class be directed?

4. One end of a magnetised bar is dipped into iron filings. Draw a diagram showing the bar "end on" and the iron filings adhering to it. Give any explanation that seems necessary.

5. A strong bar magnet is placed on a table; it lies in the magnetic meridian, with its north-seeking pole towards the north. What positions near the magnet should be chosen for a compass (1) if the north-seeking end of the compass needle is to point to the magnetic north; (2) if the south-seeking end of the compass needle is to point to the magnetic north? Illustrate your answer by a diagram.

6. Mustard seeds are grown on wet flannel. After a time the plants are found to be heavier than the original seeds. Whence have the materials necessary for the increase in weight been obtained? Name the materials in question.

7. What results may be observed when a piece of sodium is thrown into water? How do you account for the facts that you describe?

8. A piece of marble is placed in a very hot fire for an hour or two; it is taken out and allowed to cool; then water is poured on it. What changes in the stuff may be observed? What chemical actions accompany the changes in question?

9. The end of a knitting-needle, when brought near to one of the poles of a compass needle, attracts the pole in question. How can we ascertain whether the knitting-needle was magnetised originally, or whether it merely became magnetised when brought near to the compass needle?

10. Where are the magnetic poles, and where is the magnetic equator? How would you expect a dipping needle to behave if taken to these places?

11. When a candle burns in air, certain substances are produced which differ from the wax of the candle and from air. How could you prove this to a class?

12. Ancient philosophers regarded earth, air, fire, and water as the four elements of which our world is composed. What has modern chemistry to say as to the nature of these so-called elements?

13. Describe some differences between a chemical compound and a mixture. Gunpowder is a mixture of nitre, sulphur, and charcoal. How can these ingredients be separated from one another?

14. Describe experiments to illustrate the combustion of three different substances in oxygen. Name the compound formed in each case, and state how its existence may be demonstrated.

15. If you were provided with a small magnetic needle upon a pivot, and also with two bar magnets, how would you determine (1) which is the north pole of the needle; (2) which is the north end of each of the magnets; (3) whether the magnets are of equal strength or not?

16. Describe how a dipping needle may be used to determine the magnetic meridian at a place.

17. A jar of oxygen, a jar of nitrogen, and a jar of hydrogen are put before you. How can you tell which is which?

18. Sulphuric acid and common salt are heated in a flask. What substance will be produced? How would you arrange the experiment?

19. What is the "rust" of iron? Name some metal which will not rust. A piece of sodium is thrown into water, what will happen?

20. Which of the following bodies are "elements":—air, chalk, coal gas, diamond, iron, mercury, salt, soot, sulphur, water? Give your reasons for thinking that any one of the ten is not an element.

CORRESPONDENCE: RULES (as usual).

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to "Mr. A. T. Flux, The Bays, Belvedere, Kent."

ANSWERS TO CORRESPONDENTS.

An Inquirer is anxious to know whether Edward the Seventh should be included in the Hanoverian kings, or if he should be considered the first of a new dynasty.

This is a question which has been much discussed, and the answer depends upon the exact meaning attached to the word "dynasty." The present King's right to the throne is to be found in the Act of Settlement, which settled the monarchy upon Sophia and her heirs. But a son usually takes the father's name. Henry the Second commenced the Plantagenet or Angevin kings, because his father was Count of Anjou; Henry the Seventh took the name of Tudor from his father; James the First was a Stuart, because his grandfather was a Stuart; and George the First took his title from his father. Similarly, Edward the Seventh commences the line of Saxe-Coburgs. Confusion has arisen from not distinguishing the right to property from the right to a name. A son who inherits large estates from his mother retains his father's *name*.

Leaving Certificate.—The answer is quite right.

The gold in one is $\frac{2}{3}$, silver $\frac{1}{3}$; in two others, gold $\frac{3}{8}$, silver $\frac{5}{8}$; in three others, gold $\frac{7}{12}$, silver $\frac{5}{12}$.

$$\text{Total gold} = \frac{2}{3} + 2\left(\frac{3}{8}\right) + 3\left(\frac{7}{12}\right); \quad \text{silver} = \frac{1}{3} + 2\left(\frac{5}{8}\right) + 3\left(\frac{5}{12}\right)$$

$$= \frac{2}{3} + \frac{6}{8} + \frac{21}{12}; \qquad = \frac{1}{3} + \frac{10}{8} + \frac{15}{12}$$

$$= \frac{76}{24}; \qquad = \frac{68}{24}.$$

$$\text{The ratio } \frac{76}{24} : \frac{68}{24} = 19 : 17.$$

LOGIC FOR L.L.A. AND LONDON MATRICULATION.

BY T. E. MARGERISON, M.A. (LOND.),
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VIII.

Conditional Syllogisms.—The syllogisms hitherto considered have been composed of categorical propositions only. But we have seen that a proposition may be *conditional*—that is, it expresses an affirmation or a denial made subject to a condition, as, "If the wind is in the east, the weather is fine." The first part of the proposition, the part expressing the condition, is called the *antecedent*, and the remainder the *consequent*. If we are given the truth of a conditional proposition such as this, and then affirm the truth of the antecedent, evidently we can deduce the truth of the consequent, and we have what is called a *conditional syllogism* in the following form—

If the wind is in the east, the weather is fine.
The wind is in the east.
∴ The weather is fine.

The first proposition, inasmuch as it states the ground of the inference, is called the *major premise*, and the second, stating the case in which the major is applicable, is the *minor premise*.

Another syllogism may be built up from the same conditional proposition by denying the consequent, thus—

If the wind is in the east, the weather is fine.
The weather is not fine.
∴ The wind is not in the east.

The denial of the consequent justifies the denial of the antecedent, just as in the previous example the assertion of the antecedent warranted the assertion of the consequent.

It should be carefully noticed that we can draw no conclusion from the denial of the antecedent. The consequent may be the result of one or other of *several* possible causes, the antecedent expressing *one* of these. Therefore, although the antecedent be negatived, the consequent may still be true owing to the operation of some other cause. For example, take the proposition, "If a man is a thief, he is a criminal." If we deny the antecedent, we can draw no conclusion therefrom as to the truth or falsity of the consequent, for a man may be a criminal though he is not a thief. It may happen, in a particular case, that the antecedent given is the only possible antecedent of the consequent, then the denial of the antecedent involves the denial of the consequent, as in the example—

If a candidate obtains more than half marks, he is successful.
This candidate did not obtain more than half marks.
∴ This candidate was not successful.

But this only obtains in certain cases, and we cannot therefore assume it in any, the general rule being that no conclusion may be drawn from a denial of the antecedent.

The fallacy arising from violation of this rule is similar to that of illicit process of the major term, the consequent corresponding to an undistributed term in the major premise, but to a distributed term in the conclusion.

From the same principle—namely, that a consequent may be the result of one or other of several possible causes—it follows also that the assertion of the consequent does not enable us to affirm the antecedent. Take the proposition, "If a man is drunk, his gait is unsteady." It is not necessarily true that because a man's gait is unsteady therefore he is drunk, for his unsteadiness may be the result of deformity, disease, or other cause. Hence the rule that no conclusion can be drawn from an affirmation of the consequent. The fallacy arising therefrom corresponds to undistributed middle in categorical syllogisms.

Disjunctive Syllogisms.—A *disjunctive proposition* is one in which a choice is given between two or more possible predicates—thus, "Sheep are either black or white." The combination of a disjunctive major premise and a categorical minor with the conclusion drawn therefrom constitutes a *disjunctive syllogism*. Of this we have two types:—

1. *Modus ponendo tollens*, or the disjunctive syllogism, which denies by affirming. Here we affirm one of the alternatives and deny the other, thus—

Nouns are either proper or common.
London is a proper noun.
∴ London is not a common noun.

It should be observed that this form depends for its validity upon the mutual exclusiveness of the alternatives. This condition happens to be present in the above example. A noun cannot belong to both classes, and therefore its inclusion in one warrants its exclusion from the other. Take, however, the following syllogism—

Arithmetic is useful either as a mental discipline or for its practical value.
It is useful as a mental discipline.
∴ It is not useful for its practical value.

Here the conclusion is incorrect. The alternatives are not inconsistent, and the assertion of one does not justify the denial of the other.

2. *Modus tollendo ponens*, or the mood which affirms by denying, thus—

The motive was either jealousy or theft.
It was not jealousy.
∴ It was theft.

Here the denial of one alternative leaves the other to be affirmed. This form, unlike the first type, is universally valid. It is applicable also if the number of alternatives is greater than two; the denial of one justifies the affirmation of the remainder disjunctively.

Induction.—In all deductive reasoning inference proceeds rom general to particular propositions, the conclusion being less general in its application than the premises on which it is founded. We have now to consider the process by which general propositions, the starting point of the syllogism, are obtained. This process is *Induction*, defined by J. S. Mill as "inference which establishes a general proposition on the evidence of particular instances," or "that operation of the mind by which we infer that what is true in a particular case or cases, will be found true in all cases which resemble the former in certain assignable respects." It starts from particular facts, which are observed and subjected to the activity of thought, until a general law is arrived at concerning them.

Induction is the process not only of scientific inquiry, for all science consists of general laws obtained by induction, but it is also the means by which we obtain that knowledge of our surroundings which is of most value to us. That it is a difficult process is evident from its nature, from the generality of the conclusion compared with that of the premises. In deduction the conclusion is contained in the premises, and the process is one of making explicit that which was not previously recognised. In induction, on the other hand, although our observation is necessarily limited to comparatively few instances, we seek to obtain a conclusion applicable not only within the narrow range of our observation, but accepted as true of everything belonging to the class to which it relates. To analyse the process and to examine the conditions on which its validity depends is the scope of Inductive Logic.

QUESTIONS.

(Students can have their exercises corrected by sending them to the Editor, Logic Course, PRACTICAL TEACHER, and enclosing seven stamps.)

1. If the premises of a syllogism are false, does this make the reasoning false?

2. Examine the validity of the following arguments:—

(*a*) If he is well, he will come: he is not well; therefore he will not come.

(*b*) If he is well, he will come: he will come; therefore he is well.

3. Illustrate by examples the disjunctive syllogism.

4. Assuming that (1) If A is B, C is D, what inference, if any, can be drawn from each of the following further statements—(2) A is B, (3) A is not B, (4) C is D, (5) C is not D?

5. Show how the conditional syllogism is related to the categorical. Examine the following:—

(*a*) Floods in the valley are due either to heavy rains or to the melting of the snow. There has been neither of these recently, so we may be sure there will be no flood.

(*b*) It must be obvious that the stimulus of academic honours is useless, since it is unnecessary for the serious student, and is ineffectual for the indifferent.

OUR CERTIFICATE COURSE FOR 1903.

BY GEORGE COLLAR, B.A., B.SC.,
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TEST QUESTIONS ON LAST MONTH'S WORK.

THEORY OF TEACHING.

1. What should be the aims of object teaching? How would you attempt to get the greatest benefit from a course of object lessons? Make out a list of twenty object lessons for (*a*) a country school, or (*b*) a town school. (Cert.)

2. Explain the value and use of "object lessons." Say what educational purpose they may serve, and how a course of them should be arranged. Give a graduated list of twenty subjects which would be appropriate for a class of scholars of six or of ten years old. (Cert.)

ENGLISH LANGUAGE AND LITERATURE.

1. What do you mean by a "sonnet"? What is the usual form of a sonnet? Illustrate your answer by any sonnet you have committed to memory.

2. What is the use of "paraphrase" as an exercise in language? Give, as to a pupil teacher, some rules which should be observed in attempting to paraphrase a poetical extract, and add a brief example of a good paraphrase of your own of some familiar verse. (Cert.)

ENGLISH HISTORY.

1. State what you know of the "Field of the Cloth of Gold"

and its connection with the foreign policy of Henry the Eighth. What part did Wolsey play in the latter?

2. What was the Pilgrimage of Grace? State the grievances of which the rebels complained, and say how those grievances were eventually remedied.

3. Give an account of the circumstances which led to the battles of Flodden and Pinkie.

GEOGRAPHY.

1. Write an account of the three greatest rivers in Africa.

2. Give an account of the Great Karroo and the Kalahari Desert.

3. What physical features of Africa have been a bar to its development? How can you account for the remarkable absence of bays and gulfs along its coasts? (Cert.)

4. Some portions of Africa receive large quantities of rain, and some are almost rainless. How do you account for these conditions? Explain why the chief characteristics of desert climates are intense heat by day and severe cold by night. (Cert.)

ARITHMETIC.

1. At what rate per cent. per annum simple interest will £827, 10s. amount to £1,073, 13s. 7½d. in 8½ years? (Cert.)

2. What is the true discount on £512, 10s. due 2 years 8 months hence at 3½ per cent. per annum simple interest? Express your answer as the decimal of the present value of the sum (£512, 10s.). (Cert.)

EUCLID.

1. To describe a circle about a given triangle.

2. ABC is a given triangle; find the centre of a circle which shall cut off three equal chords from the sides of ABC.

3. If any straight line be drawn touching a circle, the part of it intercepted between the tangents at the extremities of any diameter subtends at the centre a right angle.

ALGEBRA.

1. Solve:—

(*a*) $\sqrt{x+a} - \sqrt{x-a} = \sqrt{x}$.

(*b*) $x^3 + 8 = 2x^2 + 11x + 14$.

(*c*) $\begin{cases} x^2 + xy + y^2 = 9. \\ x^4 + x^2y^2 + y^4 = 243. \end{cases}$

2. In the equation $x^2 - 2px + q = 0$; show that $2p$ = the sum, q = the product, $2\sqrt{p^2 - q}$ = the difference of the roots. Hence, show that if a, b are the roots of this equation, and $(a + c)$, $(b - c)$ the roots of $x^2 - 2px + r = 0$, then $c^2 + 2c\sqrt{p^2 - q} - q + r = 0$.

ELEMENTARY SCIENCE.

1. A body moves over 10 feet in the first second of the time during which it is observed, over 42 feet in the third second, and over 74 feet in the fifth second. Is this body subject to a uniform acceleration?

2. A uniformly accelerated body describes 216 feet and 280 feet in the fifth and seventh seconds of its motion respectively; find the initial velocity, and the numerical measure of the acceleration.

NOTES AND SYLLABUS FOR MARCH.

COMPOSITION.

Study Nichol, Part IV., Chap. II. There are few ways in which the writer is called upon to exercise more judgment than in deciding whether to cut down his sentences or to expand them—when to have recourse to repetition, and when to avoid it. This chapter deals with the subject in a masterly manner.

Prepare essays on—

1. "Peace hath her victories no less than war."

2. A summer evening.

3. "They never fail who fall in a great cause."

4. The effect a Channel tunnel would have on the welfare of the country.

THEORY OF TEACHING.

Study the methods of teaching writing. The objects to be aimed at are in order of importance—(1) legibility, (2) speed, (3) beauty.

Legibility depends on the form, size, and spacing of the letters, which should be nearly round. The angular "ladies' hand" should be avoided; special care should be taken with letters which tend to become similar, such as *u* and *n*; flourishes should be avoided, especially if there is not sufficient time to execute them properly—and even if there is, they do not add to the legibility, although they may add grace. Badly decorated letters are neither legible nor beautiful. A few years ago styles of writing were introduced in which the spaces between the letters were exaggerated. This was a mistake, for we read a word as a whole, and do not spell it a letter at a time. The mind requires an impression from the association of the letters, not from their dissociated forms. Some of these systems also made the letters so cramped that they were hardly legible unless viewed at a particular angle. The importance of legibility need not be dwelt on here.

We have placed speed second, although it has the most *direct* importance to the writer. Legibility chiefly concerns the reader, and concerns the writer indirectly; but it is none the less important on that account, and must never be sacrificed to speed. Speed is attained by practice, by adopting a good position for the body and good method of holding the pen, and also by avoiding loss of time in joining the letters. Most teachers now advocate writing each word without lifting the pen. Beauty, or grace, is not so much sought after now as by our forefathers. In all cases it should be subordinated to legibility; no curves or other forms should be allowed which tend to obscure the writing. The writing, as a whole, should be marked by uniformity—that is, all the small letters should be of the same height, and all the tall letters of a uniform height, and the straight portions of all letters should have the same slope, although opinions differ as to what that slope should be. Thick strokes which terminate should have an even end, and should not be pointed, as they tend to become when there is unequal pressure on the two points of the pen. If these points are attended to, the writer can proceed at a good rate, and will be able to spare a little time to embellish his work by carefully formed capitals and fancy headlines. The capitals are used so seldom that the extra time required to form them artistically is small, and they are yet common enough to give a general finish to the whole piece. In the same way a heading deserves careful writing, and we should strongly recommend the "engrossing" hand for such purposes.

Among the methods to be employed are—

1. *Copy-setting on the blackboard.*—The teacher must be able to write well, and there should be a uniform style in all the classes, which is rather difficult to obtain. A systematic sequence of copies must be followed; and in a subject which more than all others allows the gifted individuals to outdistance their classmates, this system requires that all should progress at the same rate.

2. *Copy-setting on slips of paper.*—These have the advantage of being movable, so that they can be set immediately over the line the child is writing; but they tend to become dirty and torn.

3. *The use of engraved headlines.*—These save time, are generally systematically drawn up, and offer a good model for the child to imitate. The objections are—(*a*) The child is discouraged because he thinks the writing is too good to be "done by hand;" (*b*) he repeats and exaggerates his faults in each succeeding line.

We have recently seen some copy-books published by Messrs. Chambers which combine all the advantages of (2) and (3).

School hygiene.—The case of neglected children. This has been so often and so ably set out in the appeals issued by the various associations formed for helping such, that we need do no more than remind our readers of the connection between proper food supply and efficient work, whether physical or mental. In dealing with children who are physically or mentally deficient, in spite of home attentions, most school authorities provide special schools; but the teacher should consider the nature and treatment of their deficiencies.

ENGLISH LANGUAGE AND LITERATURE.

Prepare the second book of the *Golden Treasury*. The first poem is regarded as one of the grandest in the English language, and deserves careful study. Dryden's "Song for St. Cecilia's Day" is a remarkable example of the way in which sound may be related to thought; it must be read aloud to be appreciated. The reader will then observe how the poetry is in succession descriptive of "the trumpet's loud clangour," "the double, double, double beat of the thundering drum," "the soft, complaining flute," and the "sharp violins." Note the grand poetic hyperbole in the last stanza but one—

"When to her Organ vocal breath was given,
An Angel heard, and straight appeared—
Mistaking Earth for Heaven."

Andrew Marvell, the incorruptible Parliamentary politician, was a poet of no mean order. The account of the execution of Charles the First is often quoted. In fact, the student will be astonished to see what a number of lines in this section may be described as familiar quotations; some, as the last line in Lycidas, are often quoted incorrectly. A list of lines should be made which are familiar, so that they may be associated with their sources—for example,

"They also serve who only stand and wait,"

from Milton's sonnet on his blindness.

English History.

Study the period from 1558–1660.

The following questions, taken from Certificate and other examinations, will show the chief points to be attended to:—

1. Illustrate and account for the enthusiasm felt for Elizabeth by her subjects. Was it an exceptional thing in English history?
2. Who were Elizabeth's chief advisers during the period 1558-1588, and what general line of foreign policy did they recommend?
3. What was the claim of Mary Queen of Scots to the throne? Why did the Scots rebel against her, and why did Elizabeth put her to death?
4. Who were the Puritans, and why were they a more powerful party at the end of Elizabeth's reign than in the middle of it?
5. Explain the difference between the constitutional position of James the First and Charles the First and that of their Tudor predecessors.
6. Describe the administration of Laud and Strafford, and show how it helped to bring on the Great Rebellion.
7. Explain the terms—Impositions, Spanish Marriage, and Ship Money, and state shortly how these caused conflict between the Crown and Parliament.
8. Give an account of the work of the Long Parliament up to the outbreak of the Civil War.
9. Show the importance in the Civil War of the battles of Marston Moor and Dunbar.
10. What claims has Oliver Cromwell to distinction (1) as a soldier, (2) as a statesman?
11. What was the condition of the poorer classes in the sixteenth century? Mention any legislation introduced for their relief.
12. Explain and criticise the foreign policy of Cromwell.
13. Explain the provisions of the *Instrument of Government*, and compare them with the constitution previous to the outbreak of the Civil War.
14. What services were rendered to England by Drake, Hawkins, and Raleigh?
15. Mention the chief difficulties at home and abroad with which Elizabeth had to contend at her accession. Show how she overcame them.

Geography.

Finish studying the geography of Africa, paying careful attention to South Africa. Observe that most of the mineral productions are found in the south east. They include diamonds, gold, coal, iron, lead, and marble. The vegetation of Africa is very abundant, and varies according to district. The vine flourishes, and its cultivation for wine making will no doubt soon become one of the chief industries. Fruits are so plentiful that they will probably form an important export in the future, especially as, owing to the difference in seasons, South African fruits would reach our markets at a time when fruit is comparatively scarce in the northern hemisphere. Amongst the animal productions note wool, ostrich feathers, and hides. When studying the climate of Africa, note how large a portion of the continent lies within the torrid zone, and that owing to the mass of land unbroken by gulfs, bays, etc., the influence of the ocean has very little effect on the climate. Note also the unhealthy character of the west coast, the lack of rainfall in the desert regions, and the monsoons which blow on the east coast.

Of what were formerly known as the Barbary States, Algeria is now a flourishing French colony, which sends deputies to the French Parliament. The governor-general resides in Algiers. Tunis is under French influence in the same way that Egypt is under British influence. Of the other two states—Morocco and Tripoli—the former is now occupying some attention owing to the recent rebellion. The Sultan of Morocco, who resides at Fez, is a progressive ruler, and, owing to his advanced ideas, has given offence to some of his retrograde subjects, who rose in revolt against him. The daily account of how matters are progressing in Morocco should be read in the newspapers.

In studying Egypt, the chief feature to be noticed is the Nile. Read an account of the great dam which has recently been constructed at Assouan to retain the waters of the river, so as to form a huge reservoir for use during the dry season. Amongst means of communication, the Suez Canal is most important. Since its opening the commerce of Egypt has greatly increased. The simoon, which blows from the west and south, is one of the drawbacks to the climate.

Study the railway systems of South Africa, and work out carefully the proposed "Cape to Cairo" route.

Arithmetic.

The student can now take up the section dealing with stocks and shares. It is most important that students should obtain a correct idea of the nature of stocks, as it is from imperfect knowledge on this point that difficulties arise. We should therefore recommend every one to obtain, if possible, some practical knowledge of the subject by seeing and examining share certificates, or by watching the fluctuations of the prices of certain stocks from day to day in the financial column of the daily paper. In this way the student realises that stocks are marketable commodities, just as horses, lands, or houses are. The only difficulty lies in the fact that the *price* of the stock and the *amount* are stated in the same terms—namely, £—hence confusion arises if the nature of stock is not properly grasped at the outset. At first we would advise students to work all questions step by step until they are familiar with the operations involved; but afterwards many of these steps can be omitted. For example, to find the income derived from investing £1,867 in the 3 per cents. at 97. A beginner should first follow the *actual transaction*—that is to say, should first find the amount of stock purchased—and then calculate the interest on that stock; but familiarity shows that the interest can be reckoned either on the *face value of the stock* or on the *cash buying price*. Thus, £3 is the income derived from £100 stock, or from the £97 cash which bought that stock; therefore the income is $\frac{3}{100}$ of the amount of stock, or $\frac{3}{97}$ of the money invested. Similarly, in transferring stock, at first it is advisable to sell out and invest the money in the new stock; but this can be performed in one operation by remembering that the *amounts of stock* will vary inversely as the *prices*. Alteration in income can be calculated similarly in one operation. Income varies directly as the rate of interest, and also directly with the amount of stock. But we have seen that when stock is transferred, the amount of stock varies inversely as the price; therefore the two incomes will vary directly as the rate per cent., and inversely as the prices of the stock.

Algebra.

Study the chapter on ratio, paying particular attention to the theory and definitions, as many points are proved which are useful in arithmetic as well as in algebra. The following theorem is most important:—

In the case of a series of equal fractions, each of them is equal to the sum of all the numerators divided by the sum of all the denominators.

If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} \ldots .$

each of these ratios equals $\frac{a + c + e \ldots .}{b + d + f \ldots .}$

Let $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = k.$

$\therefore$ By substitution—

$$\frac{a + c + e \ldots .}{b + d + f \ldots .} = \frac{kb + kd + kf \ldots .}{b + d + f \ldots .} = \frac{k(b + d + f \ldots .)}{b + d + f \ldots .} = k.$$

Practice alone will render the student familiar with the application of this principle as a ready means of proving identities involving fractions. For example—

If $\frac{2y + 2z - x}{a} = \frac{2z + 2x - y}{b} = \frac{2x + 2y - z}{c},$

show that $\frac{x}{2b + 2c - a} = \frac{y}{2c + 2a - b} = \frac{z}{2a + 2b - c}.$

Since (i.) $\frac{2y + 2z - x}{a}$ = (ii.) $\frac{2z + 2x - y}{b}$ = (iii.) $\frac{2x + 2y - z}{c},$

$\therefore$ each equals $\frac{\text{sum of numerators}}{\text{sum of denominators}}$ = (iv.) $\frac{3x + 3y + 3z}{a + b + c}.$

By doubling the numerator and denominator of (iv.), and trebling those of (i.), (ii.), and (iii.), the ratios are unaltered.

$\therefore$ Each of the fractions

$$= \text{(iv.)}\frac{6x + 6y + 6z}{2a + 2b + 2c} = \text{(i.)}\frac{6y + 6z - 3x}{3a}$$
$$= \text{(ii.)}\frac{6z + 6x - 3y}{3b} = \text{(iii.)}\frac{6x + 6y - 3z}{3c}.$$

By subtracting (i.), (ii.), and (iii.) respectively from (iv.), we obtain $\frac{9x}{2b + 2c - a} = \frac{9y}{2c + 2a - b} = \frac{9z}{2a + 2b - c}.$

$$\therefore \frac{x}{2b + 2c - a} = \frac{y}{2c + 2a - b} = \frac{z}{2a + 2b - c}.$$

If we have only *two* equations containing *three* unknown quantities in the first degree, we cannot completely solve these equations, but we can sometimes obtain the ratios of the three unknowns in the following way:—

(1.) $ax + by + cz = 0.$
(2.) $lx + my + nz = 0.$

By writing these (1.) $\frac{ax}{z} + \frac{by}{z} + c = 0$,

(2.) $\frac{bx}{z} + \frac{my}{z} + n = 0$,

we have now a simultaneous equation, of which $\frac{x}{z}$ and $\frac{y}{z}$ are the unknown quantities, the value of which can be found in the ordinary way.

EUCLID.

Prepare the first four propositions of Book VI. These should present no difficulties, but there are one or two points that should be noticed in passing. In Prop. I., although Euclid only proves that triangles and parallelograms of the same altitude are to one another as their bases, it is obvious, and may be assumed in proving deductions, that, if the bases are equal, the triangles are to one another as their altitudes. Note in Prop. III. that if the triangle is isosceles, the line bisecting the vertical angle also bisects the base. Students should combine Props. III. and IIIA; in each case we have segments having the same ratio as the sides of the triangle, therefore the ratios between the segments in each case are equal.

ELEMENTARY SCIENCE.

We can now define gravitation, which is the force that tends to draw all bodies together. It was discovered by Newton that gravitation is proportional to the product of the masses of the bodies, and inversely proportional to the square of the distance between them. He established this theory by calculations on the motion of the moon compared with motions of bodies falling near the surface of the earth. The importance of the discovery cannot be exaggerated, as it has formed the basis for the calculation of the motions of the various heavenly bodies; and the agreement of the actual result with the predicted result forms a corroboration of the correctness of the theory.

Weight.—Weight is due to gravitation, and is therefore regulated by the law stated above. We can, however, modify this statement in applying it to weight. In comparing the weights of two bodies, it is not necessary to take the *products* of the respective masses and the earth; for as the mass of the earth is constant, the weights of the two bodies vary directly as their masses—assuming, of course, that they are weighed at the same distance from the centre of the earth. This should be carefully noted, as it explains why *mass* and *weight* are expressed in identical terms, although they are two totally different things. If the distance from the centre of the earth is increased, the weight of a body will decrease in accordance with the law of gravitation; hence if a body is weighed at the top of a mountain, it will be found to weigh less than at the foot. The weighing, however, must be done by means of a spring balance; for the weights used as a counterpoise in a common balance decrease in weight exactly as the body being weighed does, so there is apparently no alteration in weight.

Weight of Bodies in Air and Water.—A cubic foot of iron weighs about 450 lbs. If it is suspended in a vessel of water, it displaces a cubic foot of water, weighing 65½ lbs. It is obvious that this 65½ lbs. of water which has been displaced was originally supported by an upward pressure of the water beneath it equal to 65½ lbs.; and although we have substituted a foot of iron for the foot of water, the upward pressure remains the same, so the iron will lose 65½ lbs. of its weight. If we suspend a cubic foot of any other substance, we find that it also will lose 65½ lbs. of its weight owing to the upward pressure of the water.

If possible, the student should weigh a number of bodies first in air and then in water, and in every case it will be found that *when a body is immersed in water it loses weight equal to the weight of an equal volume of water.* This is known as the Principle of Archimedes.

Specific Gravity.—Every one is familiar with the catch question, "Which is heavier, a pound of lead or a pound of feathers?" Although the weights, and therefore the masses, are equal, the volume of 1 lb. of lead is much less than that of 1 lb. of feathers; in other words, the matter in the lead is packed more tightly than the matter in the feathers, therefore we say its *density* is greater. In comparing the densities of different substances, we take the density of water as the standard, and the ratio between the density of any substance and the density of water is said to be the specific gravity of the substance. Since $density = \frac{\text{mass}}{\text{volume}}$, the densities of bodies of equal volume will vary as their masses or as their weights; hence, taking the density of water as unity, specific gravity of

$$A = \frac{\text{mass (or weight) of A}}{\text{mass (or weight) of equal volume of water}}.$$

In the case of liquids, we can easily get equal volumes of the liquid and of water by means of a specific gravity bottle; while the principle of Archimedes furnishes a ready means of determining the specific gravity of any solid whose density is greater than that of water. Thus, to find the specific gravity of a piece of lead whose

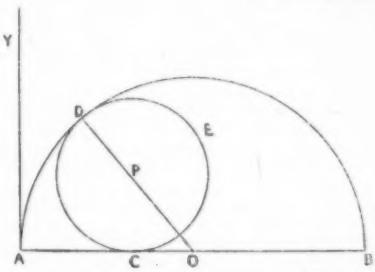
Weight in air = 22·7 grammes
Weight in water = 20·7
Weight of an equal volume of water = 2·

$\therefore$ Specific gravity of lead $= \frac{22{\cdot}7}{2} = 11{\cdot}35$.

OUR QUERY COLUMN.

RULES (as usual).

Fragselig.—A circle is described touching a given straight line AB at C, and having its diameter a harmonic mean between the segments AC, CB. Prove that it touches the circle on AB as diameter. (Cambridge Entrance.)



Let AC = a, CB = b, and therefore AB = $a + b$. Then the circle DEC described as directed in question has its radius = $\frac{ab}{a+b}$. For if r be the radius of this circle, then, by the question, a, $2r$, and b are in H.P., therefore $a - 2r : 2r - b :: a : b$, and hence $r = \frac{ab}{a+b}$. Taking A as the origin, and AB and AY perpendicular to AB as the axes of co-ordinates, the equation of the circle CED is

$$(x-a)^2 + \left(y - \frac{ab}{a+b}\right)^2 = \left(\frac{ab}{a+b}\right)^2,$$

or, on reducing,

$$x^2 - 2ax - 2\frac{ab}{a+b}y + y^2 + a^2 = 0 \quad \ldots\ldots \text{(i).}$$

Again, the equation of the circle on AB as diameter is—

$$\left(x - \frac{a+b}{2}\right)^2 + y^2 = \left(\frac{a+b}{2}\right)^2;$$

or,

$$x^2 - (a+b)x + y^2 = 0 \quad \ldots\ldots \text{(ii).}$$

Subtracting (i) from (ii), we obtain—

$$(a-b)x + \frac{2ab}{a+b}y - a^2 = 0;$$

or,

$$(a^2 - b^2)x + 2aby - a^2(a+b) = 0 \quad \ldots \text{(iii),}$$

which is the equation of the chord of intersection of the two circles.

The length of the perpendicular from the centre of the circle (ii) upon the chord (iii) is—

$$\frac{(a^2-b^2)\frac{a+b}{2} - a^2(a+b)}{\pm\sqrt{\{(a^2-b^2)^2 + (2ab)^2\}}},$$

and this reduces to $\pm\frac{a+b}{2}$.

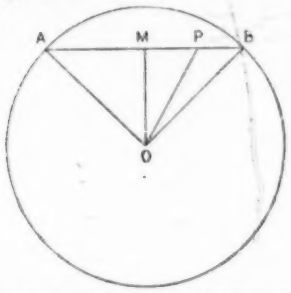
But the radius of the circle (ii) is equal to $\frac{a+b}{2}$. Hence the chord of intersection of the two circles is a tangent to the circle (ii), and, therefore, the two circles touch one another.

Bike.—Prove that a train on a perfectly straight railway, not curved to the radius of the earth, will oscillate if unresisted on each side of the position of equilibrium in the same period as a grazing satellite, about $\frac{1}{17}$th of a day, or 1 hour 25 minutes. (B.Sc., 1902.)

A uniform spherical shell of matter exerts no resultant

attraction on a particle inside it. A homogeneous solid sphere attracts a particle outside it just as if all the matter of the sphere were concentrated at the centre.

If ρ be the density, r the radius, the mass of the sphere is $\frac{4}{3}\pi r^3\rho$; and the attraction being directly as the mass and inversely as the square of the distance from the centre, it follows that the attraction on a particle at the surface of the sphere varies directly as the distance from the centre, and equals fr, say, and is in the direction of the radius through the particle.



Let AB be the straight railway, M the mid point of AB, and O the centre of the earth. A particle at P is attracted towards O by a force f. PO. The resolved attraction towards M is f. PO cos OPM—that is, f. PM. Therefore the motion of the particle is simple harmonic along AB. The time of an oscillation is $\frac{2\pi}{\sqrt{f}}$. But the time of revolution of a grazing satellite is also $2\pi \div \sqrt{f}$; because such a satellite, at B say, would have an acceleration towards O equal to f. BO. But this acceleration is also $\frac{v^2}{r}$, or $\omega^2 r$, and the time of a revolution is $\frac{2\pi}{\omega}$; that is, $2\pi \div \sqrt{f}$.

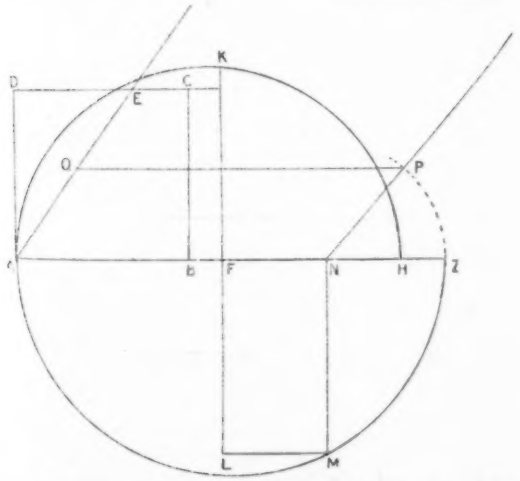
The acceleration of a body on the surface of the earth is g, or 32, say, in foot-second units.

$\therefore\ 32 = \omega^2 r$, where r is the radius of the earth in feet; and $\omega = \frac{2\pi}{t}$, where t is the number of seconds in a revolution round the earth.

$$\therefore\ t^2 = \frac{4\pi^2 \times 4000 \times 5280}{32}.$$

$$\therefore\ t = 200 \times \sqrt{66\pi} \text{ seconds} = \underline{1 \text{ hour } 25 \text{ minutes}}.$$

Cumbrian.—Describe a parallelogram equal in area to a given square, having its perimeter equal to a given straight line, and having an angle equal to a given angle. When is this impossible? (Tutorial Geometry.)



Let ABCD be the given square, AZ *half* the given straight line, and ZAE equal to the given angle. Let AE meet CD, or this line produced, in the point E. On AZ take AF = AE, and FH = AB. On AH as diameter describe the circle AKH. Draw FK at right angles to AH, and cutting the circle AKH in the point K. Produce KF to L, making FL = FK. Draw LM parallel to AZ, and meeting the circle described on AZ as diameter in the point M. Draw MN perpendicular to AZ. Draw NP parallel to AE and equal to NZ. Complete the parallelogram ANPQ. This is the required parallelogram.

The area of the parallelogram ANPQ = AN.NP sin ZAE = AN.NZ sin ZAE = NM^2 sin ZAE = FK^2 sin ZAE = HF.FA sin ZAE = AB.AE sin ZAE = AB.AD = AB^2. And since NP = NZ, the perimeter of ANPQ is double the line AZ; also the angle NAQ is equal to the given angle. Therefore ANPQ is the required parallelogram.

The solution is impossible when the given straight line is less than the perimeter of the given square.

Glum.—Show that $(x^2 - yz)^3 + (y^2 - zx)^3 + (z^2 - xy)^3 - 3(x^2 - yz)(y^2 - zx)(z^2 - xy)$ is a perfect square.

Since $a^3 + b^3 + c^3 - 3abc \equiv (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$.

$$\therefore (x^2 - yz)^3 + (y^2 - zx)^3 + (z^2 - xy)^3 - 3(x^2 - yz)(y^2 - zx)(z^2 - xy)$$
$$\equiv \{(x^2 - yz) + (y^2 - zx) + (z^2 - xy)\}\{(x^2 - yz)^2 + (y^2 - zx)^2 + (z^2 - xy)^2 - (x^2 - yz)(y^2 - zx) - (y^2 - zx)(z^2 - xy) - (z^2 - xy)(x^2 - yz)\}$$
$$\equiv \{x^2 + y^2 + z^2 - xy - yz - zx\}\{(x^2 - yz)(x^2 - yz - y^2 + zx) + (y^2 - zx)(y^2 - zx - z^2 + xy) + (z^2 - xy)(z^2 - xy - x^2 + yz)\}$$
$$\equiv \left\{\frac{x^3 + y^3 + z^3 - 3xyz}{x + y + z}\right\}\{(x^2 - yz)(x - y)(x + y + z) + (y^2 - zx)(y - z)(x + y + z) + (z^2 - x)(z - x)(x + y + z)\}$$
$$\equiv \frac{x^3 + y^3 + z^3 - 3xyz}{x + y + z} \cdot (x + y + z)\{(x^2 - yz)(x - y) + (y^2 - zx)(y - z) + (z^2 - xy)(z - x)\}.$$
$$\equiv (x^3 + y^3 + z^3 - 3xyz)\{x^2 + y^2z - x^2y - xyz + y^3 - xyz - y^2z + z^2x + z^3 - xyz - xz^2 + x^2y\}$$
$$\equiv (x^3 + y^3 + z^3 - 3xyz)(x^3 + y^3 + z^3 - 3xyz).$$

Hence the given expression is a perfect square.

J. B. Holmyard.—A mixture of silver with three other metals contains a per cent. silver, and b, c, d per cent. of the other three respectively; after refining, the amount of silver remains the same, and is A per cent. of the remaining mass, while the other metals form B, C, D per cent. respectively. What percentage of each metal has been removed? (L.C.P. Examination.)

Let the *names* of the metals partially removed be denoted by β, γ, δ in the order given in question. Let m be the mass of the mixture to begin with, and M the mass left after refining. Then, by the question, the amount of silver in the mass m is $a \cdot \frac{m}{100}$, and the amount of silver in the mass M is $A \cdot \frac{M}{100}$. Further, by the question, we have

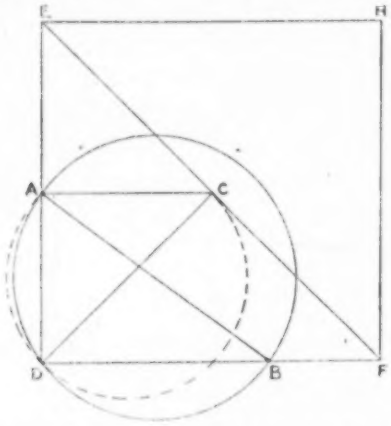
$$a\frac{m}{100} = A\frac{M}{100}.$$

$$\therefore M = \frac{a}{A}m \quad \ldots\ldots\ldots \text{(i).}$$

Again, since there is B per cent. of the metal β left in the mass M, the mass of β left in M is $B \cdot \frac{M}{100}$, and this, by (i), is equal to $B\frac{a}{A}\frac{m}{100}$. Now, originally we had $b \cdot \frac{m}{100}$ of the metal β in the mixture. Hence, by refining, we have removed $b\frac{m}{100} - B\frac{a}{A}\frac{m}{100}$—that is $\left(b - \frac{Ba}{A}\right)\frac{m}{100}$—of the metal β from the original mixture. But the amount of the metal β in the original mixture was $b \cdot \frac{m}{100}$. Hence the amount removed is $\left(\frac{Ab - Ba}{A} \cdot \frac{m}{100} \div b \cdot \frac{m}{100}\right)$ of the amount originally present—that is, $\frac{Ab - Ba}{Ab} \cdot 100$ *per cent.* of the amount *originally present.*

Similarly, we may show that of the metal γ $\frac{Ac - Ca}{Ac} \cdot 100$ *per cent.*, and that of the metal δ $\frac{Ad - Da}{Ad} \cdot 100$ *per cent.*, of the amounts originally present have been removed.

Junius.—Show how to construct a square which shall have two adjacent sides passing through two given points, and the intersection of the diagonals at a third given point. Show that there are generally two solutions. (S.K. Mathematics.)

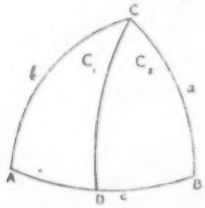


Let A, B be the two given points and C the third given point. Join AB, AC. On AB as diameter describe a circle ABD. On AC describe a segment of a circle ACD containing an angle equal to half a right angle, and cutting the circle ABD in D. Join DA, DB, DC. Through C draw ECF at right angles to DC, and cutting DA, DB in E, F. Draw EH parallel to DF, FH parallel to DE. Then DFHA shall be the required square.

Because ADB is a right angle, and ADC is half a right angle (construction), therefore CDB is half a right angle. Hence, in the triangles ECD, FCD the angles ECD, EDC are equal to the angles FCD, FDC, each to each, and the side CD is common; therefore DE is equal to DF, and CE to CF. Also, since EDFH is a parallelogram by construction, therefore EH is equal to DF, and FH to DE. Hence EDFH is equilateral. And FDE is a right angle (construction); therefore EDFH is a square. Again, C is the middle point of the diagonal EF, therefore C is the point of intersection of the diagonals of the square EDFH.

If the segment be described on the side of AC on which AB lies, there will be one solution; if on the other side of AC, there will in general be another solution.

Boot.—From the vertex C of a spherical triangle an arc of a great circle is drawn to meet the base AB in D; if C_1 and C_2 are the segments of the angle C, respectively opposite AD and BD, show that cot CD sin C = cot *a* sin C_1 + cot *b* sin C_2. (S.K. Mathematics.)



$$\text{Cot } a \sin \text{CD} = \cot \text{CDB} \,.\, \sin C_2 + \cos \text{CD} \,.\, \cos C_2.$$

$$\text{Therefore, } \cot \text{CDB} = \frac{\cot a \sin \text{CD} - \cos \text{CD} \cos C_2}{\sin C_2}.$$

$$\text{Similarly, } \cot \text{CDA} = \frac{\cot b \,.\, \sin \text{CD} - \cos \text{CD} \cos C_1}{\sin C_1}.$$

But $\cot \text{CDA} = -\cot \text{CDB}$,

therefore, $\sin C_1 \cot a \sin \text{CD} - \sin C_1 \cos C_2 \cos \text{CD}$
$= \sin C_2 \cos C_1 \cos \text{CD} - \sin C_2 \cot b \sin \text{CD}$;

therefore, $\cot a \sin C_1 - \sin C_1 \cos C_2 \cot \text{CD}$
$= \sin C_2 \cos C_1 \cot \text{CD} - \sin C_2 \cot b$;

therefore, $\cot \text{CD} (\sin C_1 \cos C_2 + \cos C_1 \sin C_2)$
$= \cot a \sin C_1 + \cot b \sin C_2$;

therefore, $\cot \text{CD} \,.\, \sin (C_1 + C_2) = \cot a \sin C_1 + \cot b \sin C_2$;

therefore, $\cot \text{CD} \sin \text{C} = \cot a \sin C_1 + \cot b \sin C_2$.

Esk.—Light from a small luminous object traverses a convex lens directly, and after reflection at a plane mirror, again passes through the lens, and forms an image coincident with the object. Show that the image formed may be either erect or inverted, and trace the paths of the rays in the two cases.
(Advanced Light, Science and Art Day Exam., 1899.)

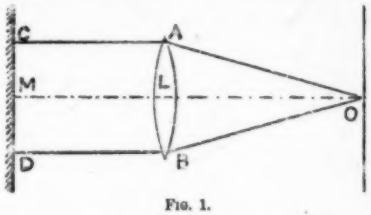


Fig. 1.

When the final image is inverted, the object must be placed at the first principal focus of the lens, the plane mirror being placed behind the lens, perpendicular to the axis of the latter. Let O (Fig. 1) be the object, such as a small illuminated aperture in a white screen. Then if O is at the first principal focus of the convex lens L, the divergent rays OA, OB, from the middle point of the aperture, will be rendered parallel to each other and to the axis of L after passing through the latter, and will fall normally on the plane mirror M, and so be reflected back along their previous paths. Thus the middle point of the final image will coincide with the middle point of the object; a displacement of the mirror M will make no difference, except in the brightness of the image, so long as the mirror remains perpendicular to the axis of the lens. That the final image will be inverted can be seen from the following reasoning. If an object is placed on the axis of a convex lens, at a point nearer to the lens than the first principal focus, a virtual erect image is formed, farther from the lens than the object, and on the same side of the lens as the object. As the object is moved away from the lens toward the first principal focus, the virtual image recedes from the lens, and is formed at infinity when the object reaches the first principal focus. Thus, in Fig. 1, by the first refraction through the lens, a virtual erect image is formed at an infinite distance to the right of M, and this gives rise, by reflection in M, to a virtual erect image at an infinite distance to the left of M. This latter image serves as object in the second refraction through the lens, and being erect, and at an infinite distance from the lens, gives rise to an *inverted* image at the principal focus of L—that is, in the same plane as the object O.

For an erect image coinciding with the object O to be formed, the lens L and the mirror M must be adjusted so that, by the first refraction through L, an image is formed on the surface of M. This image at C (Fig. 2) is, of course, inverted, and as it serves as object in the second refraction through L, and C is conjugate to O, it follows that an erect image is formed in the same plane as the object O. This image will be thrown out of focus by displacing M. The ray OA (Fig. 2) gives rise to the ray AC, which is reflected

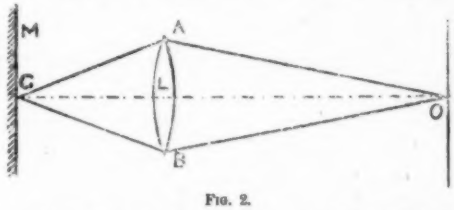


Fig. 2.

from M at C, and then traverses the path CBO, so that the middle point of the final image coincides with the middle point of the object.

A.J.J.P.—Three bodies are projected simultaneously in the same vertical plane, one vertically upwards, another at the angle of elevation 30°, and the third horizontally. If their velocities be in the ratio $1 : 1 : \sqrt{3}$, prove that they will always be in a straight line. How does this line move in space?
(Hicks's *Elementary Dynamics.*)

In the plane of projection, let the point from which the bodies are projected be chosen as the origin, the axis of *y* being vertical, while the axis of *x* is horizontal, its positive

direction coinciding with direction of projection of the third body. Let the velocities of the bodies be respectively equal to v, v, and $\sqrt{3}v$. Then, if y_1, x_1 are the co-ordinates of the first body at a time t after projection, we have—

$$\left.\begin{aligned} y_1 &= vt - \tfrac{1}{2}gt^2 \\ x_1 &= 0 \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

If y_2, x_2 are the co-ordinates of the second body (that projected at an elevation of 30°), after the same time t, we have—

$$\left.\begin{aligned} y_2 &= \tfrac{1}{2}vt - \tfrac{1}{2}gt^2 \\ x_2 &= \frac{\sqrt{3}}{2}vt \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

since the vertical component of the velocity of projection is in this case equal to $v \sin 30° = v/2$, while the horizontal component is equal to $v \cos 30° = v\sqrt{3}/2$.

If y_3, x_3 are the co-ordinates of the third body after the same time t, we have—

$$\left.\begin{aligned} y_3 &= -\tfrac{1}{2}gt^2 \\ x_3 &= \sqrt{3} \,.\, vt \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The equation to the straight line drawn through the points (x_1, y_1) (x_2, y_2) is—

$$\frac{x - x_1}{x_1 - x_2} - \frac{y - y_1}{y_1 - y_2} = 0.$$

(See Loney's *Co-ordinate Geometry*, p. 39.)

Therefore the equation to the straight line drawn through the first and third bodies at the end of a time t after projection is, from (1) and (3)—

$$\frac{x - 0}{0 - \sqrt{3} \,.\, vt} - \frac{y - (vt - \tfrac{1}{2}gt^2)}{vt - \tfrac{1}{2}gt^2 - (-\tfrac{1}{2}gt^2)} = 0.$$

$$\therefore \frac{x}{\sqrt{3}} + y - vt + \tfrac{1}{2}gt^2 = 0. \quad . \quad (4)$$

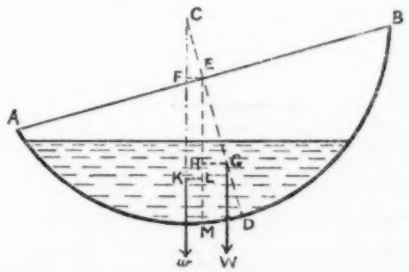
The second body will also be situated on this straight line, if the values of x_2, y_2, given in (2) will satisfy (4). Substituting $x = x_2$, $y = y_2$, in (4), we obtain—

$$\frac{\frac{\sqrt{3}}{2}vt}{\sqrt{3}} + \tfrac{1}{2}vt - \tfrac{1}{2}gt^2 - vt + \tfrac{1}{2}gt^2 = \frac{vt}{2} - \frac{vt}{2} = 0.$$

Since this condition is satisfied for all values of t, the three bodies will always be in the straight line given by (4). This straight line is inclined to the axis of x at a constant angle, $\tan^{-1}\left(-\frac{1}{\sqrt{3}}\right) = 150°$; and since it always passes through (x_1, y_1), its perpendicular distance from the origin at time t is equal to $(vt - \frac{1}{2}gt^2) \cos 30° = \frac{1}{2}(vt - \frac{1}{2}gt^2)$. Hence the variable velocity of the line, in a direction perpendicular to its length, is equal to $\frac{\sqrt{3}}{2}(v - gt)$.

Bike.—Prove that a tilting basin of thin metal in the form of a segment of a spherical surface, movable about a diameter of the base, will not upset when water is poured into it, if the weight of the basin exceeds {(radius of base/height of basin)^2 − 1} times the weight of water. (B.Sc., London, Nov. 1902.)

This is a problem on stability of equilibrium, involving the determination of the centre of gravity of a segment of a spherical surface. Full explanations of the determination of centres of gravity by the aid of the calculus can be found in Edser's *Differential and Integral Calculus for Beginners* (Nelson and Sons).



Let C (Fig.) be the centre of the spherical surface, of which the basin is a segment, and let ADB be a section of the basin, through that radius CD of the sphere which is perpendicular to the orifice (or base) of the basin. Let the basin be capable of rotation about a line through E, perpendicular to the plane of the paper. This line constitutes a diameter of the base of the basin. Let G, a point on the line CD, be the centre of gravity of the basin. When water is contained by the basin, its surface will, of course, be horizontal; the water will thus form a segment of the sphere of which C is the centre. The centre of gravity of the water will always be situated at some point K on the vertical line CK drawn through C. Let w be the weight of the water acting at K, while W is the weight of the basin acting at G. If the basin is slightly tilted, the moment of the weight of the basin, about the axis of rotation, will tend to right it, while the moment of the weight of the water, about the same axis, will tend to upset it. Thus the condition of stability is that the moment of the weight of the basin shall exceed the moment of the weight of the water.

Consequently, if we draw the vertical line EM, and draw GH, FE, and KL perpendicular to EM, we must have

$$W \times HG > w \times KL.$$

The limiting case will occur when

$$W \times HG = w \times KL = w \times FE.$$

Let the angle ECF through which the basin is tilted be denoted by ϕ. Then

$$HG = EG \sin \phi.$$
$$FE = CE \sin \phi.$$

Then for stable equilibrium

$$W \times EG \sin \phi > w \times CE \sin \phi.$$
$$\therefore W \times EG > w \times CE. \quad . \quad . \quad . \quad . \quad (1)$$

Let the radius CD of the spherical surface of which the basin forms a segment be denoted by R, while the radius EB of the circular base of the basin is equal to r, and the height ED of the basin is equal to h. Then

$$CE = R - h.$$

To determine EG, we must find the centre of gravity of the spherical segment ADB. Let ρ be the mass per unit area of the basin. Consider a narrow annular strip of the basin cut off by two parallel planes which are perpendicular to the axis CD. Let the diameter of the annulus subtend an angle 2θ at C, while the width of the strip is equal to $R d\theta$. Then, since the radius of the annulus is equal to $R \sin \theta$, the area of the annulus will be equal to $2\pi R \sin \theta \times R d\theta$, and the mass of the annulus will be equal to ρ times this quantity. The centre of gravity of the annulus will be at its geometrical centre—that is, on the line CD, at a distance $R \cos \theta$ from C. Thus the moment of the annular strip of the basin about the point C will be equal to

$$2\pi\rho R^3 \sin \theta \cos \theta \, d\theta.$$

Then, if G is the centre of gravity of the complete bowl ADB, the diameter, AB, of the orifice of which subtends an angle α (say) at C, we have, by the general formula for the position of the centre of gravity,

$$CG = \frac{2\pi\rho R^3 \int_0^{\alpha} \sin \theta \cos \theta \, d\theta}{2\pi\rho R^3 \int_0^{\alpha} \sin \theta \, d\theta} = \frac{R}{2} \frac{{}_0^{\alpha}\left[\sin^2 \theta\right]}{{}_0^{\alpha}\left[-\cos \theta\right]} = \frac{R}{2} \frac{\sin^2 \alpha}{1 - \cos \alpha}$$

$$= \frac{(R \sin \alpha)^2}{2R(1 - \cos \alpha)} = \frac{(EB)^2}{2ED} = \frac{r^2}{2h}.$$

Further, by a property of the circle,

$$(2R - h)h = r^2. \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$
$$\therefore CG = \frac{r^2}{2h} = R - \frac{h}{2},$$

$$EG = CG - CE = R - \frac{h}{2} - (R - h) = \frac{h}{2}.$$

Substituting in (1), we obtain

$$W \times \frac{h}{2} > w \times (R - h).$$

$$\therefore W > w \,.\, \left(\frac{2R}{h} - 2\right).$$

And since, from (2),

$$\frac{2R}{h} - 2 = \frac{2R - h}{h} - 1 = \frac{r^2}{h^2} - 1,$$

we obtain

$$W > w\left(\frac{r^2}{h^2} - 1\right).$$

Corporal Trim.—Prove that if, at a point on the curve $\phi(x, y) = 0$, we have $\phi_x = 0$, $\phi_y = 0$ simultaneously, then two (real or imaginary) branches of the curve pass through that point, whose directions are given by the equation

$$\phi_{xx} + 2\phi_{xy}\frac{dy}{dx} + \phi_{yy}\left(\frac{dy}{dx}\right)^2 = 0.$$

Hence show that the point is a node, a cusp, or an isolated point, according as $(\phi_{xy})^2 \gtrless \phi_{xx}\phi_{yy}$ (Lamb's *Calculus*, p. 608.)

In this problem the symbol ϕ_x is used to denote the quantity commonly represented by $\frac{\partial\phi}{\partial x}$; that is, the partial derivative of $\phi(x, y)$ with respect to x. Similarly, ϕ_{xy} represents $\frac{\partial^2\phi}{\partial x\,\partial y}$, etc. We shall here use the ordinary notation.

For any point on the curve $\phi(x, y) = 0$, we must have

$$\frac{\partial\phi}{\partial x} + \frac{\partial\phi}{\partial y}\cdot\frac{dy}{dx} = 0.$$

$$\therefore \frac{dy}{dx} = -\frac{\frac{\partial\phi}{\partial x}}{\frac{\partial\phi}{\partial y}}. \quad \ldots\ldots\ldots \quad (1)$$

When either $\frac{\partial\phi}{\partial x}$ or $\frac{\partial\phi}{\partial y}$ is finite, or when both are finite, we obtain a definite value for $\frac{dy}{dx}$, which may be finite, zero, or infinitely great. In these cases only a single branch of the curve passes through the point, since there is only a single tangent to the curve at the point.

When, for the given point, $\frac{\partial\phi}{\partial x} = 0$, and $\frac{\partial\phi}{\partial y} = 0$ simultaneously, the value of $\frac{dy}{dx}$ assumes the indeterminate form $\frac{0}{0}$.

In this case we must differentiate the numerator and denominator of (1), in order to find the limiting value of $\frac{dy}{dx}$. Then

$$\frac{dy}{dx} = -\frac{\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial x\partial y}\frac{dy}{dx}}{\frac{\partial^2\phi}{\partial y\partial x} + \frac{\partial^2\phi}{\partial y^2}\frac{dy}{dx}}. \quad \ldots\ldots\ldots \quad (2)$$

From (2) we obtain the quadratic equation, to determine $\frac{dy}{dx}$,

$$\frac{\partial^2\phi}{\partial y^2}\left(\frac{dy}{dx}\right)^2 + 2\frac{\partial^2\phi}{\partial y\partial x}\left(\frac{dy}{dx}\right) + \frac{\partial^2\phi}{\partial x^2} = 0, \quad \ldots\ldots \quad (3)$$

since $\frac{\partial^2\phi}{\partial x\partial y} = \frac{\partial^2\phi}{\partial y\partial x}$.

Since a quadratic equation possesses two roots, both real or both complex, (3) gives two real or complex values of $\frac{dy}{dx}$, so that two branches of the curve, both real or both imaginary, pass through the point.

Solving (3) for $\frac{dy}{dx}$, we obtain

$$\frac{dy}{dx} = -\frac{\frac{\partial^2\phi}{\partial y\partial x}}{\frac{\partial^2\phi}{\partial y^2}} \pm \frac{1}{\frac{\partial^2\phi}{\partial y^2}}\sqrt{\left(\frac{\partial^2\phi}{\partial y\partial x}\right)^2 - \frac{\partial^2\phi}{\partial x^2}\cdot\frac{\partial^2\phi}{\partial y^2}}.$$

When the quantity under the radical sign is greater than zero, two real but different values of $\frac{dy}{dx}$ are obtained, and two real branches of the curve pass through the point. In this case the point is a *node*.

When the quantity under the radical sign is equal to zero, we obtain two coincident values of $\frac{dy}{dx}$. In this case the point is a *cusp*.

When the quantity under the radical sign is less than zero, its square root becomes imaginary, and two complex values of $\frac{dy}{dx}$ are obtained. In this case the two branches of the curve which pass through the point are imaginary, and the point itself is an *isolated point*.

Sphere.—A ball of glass contains a concentric spherical cavity. Show that, provided the radius of the cavity does not exceed the radius of the ball divided by the index of refraction, μ, of the glass, it will appear to an eye at any distance from the ball to be μ times greater than it really is.

(Heath's *Geometrical Optics*, Chap. III., No. 11.)

Let the two concentric circles in Fig. 1 represent the central sections of the glass ball and its spherical cavity. Draw the straight line CF through the common centre of the ball and cavity, and let us term this line the axis. Let us suppose that the extreme edge of the image of the

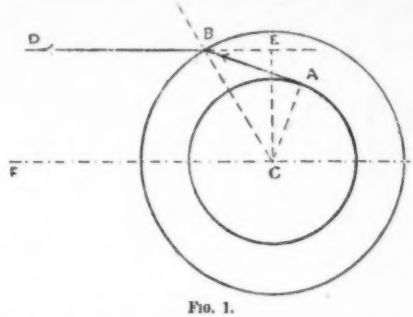


Fig. 1.

cavity is viewed in a direction parallel to the axis; then it will be observed by means of a ray such as BD, which travels, after leaving the ball, in a direction parallel to the axis, and originated at a point A of the cavity, leaving that point in a direction tangential to the cavity. Produce DB to E, and draw CE perpendicular to BE. Then the size of the cavity will be estimated in terms of the length of the line EC. Further, the ray BD is refracted into the air at an angle equal to $\angle$ CBE, the corresponding angle of incidence being equal to $\angle$ CBA. Then—

$$\sin \text{CBE} = \mu \sin \text{CBA}.$$

Let the radius of the spherical cavity be equal to r, while the radius of the ball is equal to R. Then $\sin \text{CBE} = \text{EC/BC} = \text{EC/R}$; $\sin \text{CBA} = \text{AC/BC} = r/\text{R}$. Then—

$$\frac{\text{EC}}{\text{R}} = \mu\frac{r}{\text{R}}.$$

$$\therefore \text{EC} = \mu r.$$

Thus the cavity will appear to be μ times its natural size. The limiting case occurs when the cavity is so large that the extreme ray from its edge which is transmitted parallel to the axis leaves the glass tangentially (Fig. 2). In this

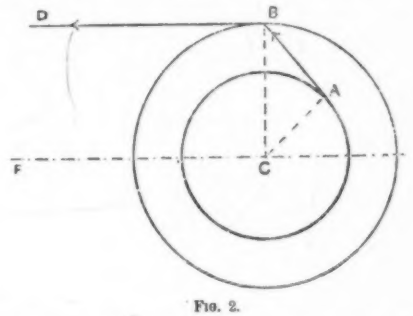


Fig. 2.

case the ray AB is incident at the critical angle, so that the angle of refraction into the air is equal to $\pi/2$, and

$$1 = \mu\frac{\text{AC}}{\text{CB}} = \frac{\mu r}{\text{R}}.$$

$$\therefore r = \frac{\text{R}}{\mu}.$$

In this case the image of the cavity will appear to come right up to the edge of the ball.

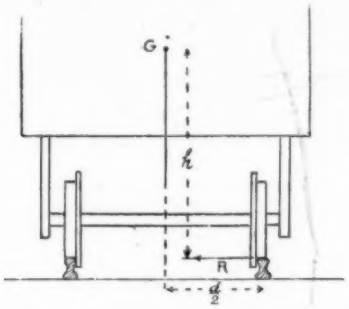
J. Cornwell.—An engine is running on level rails round a curve of radius r, the distance between the rails is d, and the height of the centre of gravity above the rails is h. Prove that if the velocity exceed $\sqrt{\frac{grd}{2h}}$ the engine will fall.

Show whether in general for a particular carriage it would be safer for the engine to push or pull a train.

When a body of weight W or mass M is moving in a circle, the normal force acting at every instant to deflect it from its straight-line path (usually called the centrifugal force) is given by

$$\text{F} = \frac{\text{W}v^2}{gr}, \text{ or } \frac{1}{2}\frac{\text{M}v^2}{r}$$

(where W denotes the weight and M the mass of the body, v the velocity of the body in feet per second, r is the radius of the circular path in feet, and g the acceleration due to gravity). To balance this there must be a force supplied by the flange against the rail A; denote this by R.



The weight (W) of the engine may be supposed to act at its centre of gravity G. Then taking moments about A, the moment of F is $F \times h$, and the moment of W is $W \times \frac{d}{2}$.

So long as the moment of the weight is greater than the moment of F, equilibrium is stable. When Fh is greater than $W \times \frac{d}{2}$, the engine will overturn, and is just on the point of overturning when $Fh = W \times \frac{d}{2}$, and this obviously gives the limiting speed.

Thus we have $F \times h = W \times \frac{d}{2}$.

And substituting for F,

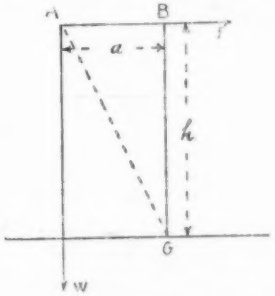
$$\frac{Wv^2}{gr} \times h = W \times \frac{d}{2}.$$

$$\therefore v = \sqrt{\frac{grd}{2h}}.$$

If the engine is pushing a given carriage, the pressure on the outer rail A is increased, and therefore the tendency to overturn. The reverse occurs during the process of pulling; hence it is safer for the engine to pull than to push.

The preceding is probably the simplest method of treating the problem; more accurately, in addition to the centrifugal action, there is the gyroscopic action of the rotating wheels to be taken into account, this gyroscopic action increasing the pressure on the outer rail and diminishing the pressure on the inner, and therefore increasing the tendency to overturn the engine.

Caron.—Prove that a horse weighing W lbs. can exert a horizontal pull of $Wa \div h$ pounds at a height h above the ground by advancing his centre of gravity a distance a in front of the position when standing upright on his legs.



Let A denote the initial position of the centre of gravity, and B the second position at a distance a from A.

In the first position the weight W will act in the vertical line passing through A, and in the second position through B. Let the perpendicular through B meet the surface in G. Then taking moments about G, we should obtain

$$Fh = W \times a,$$

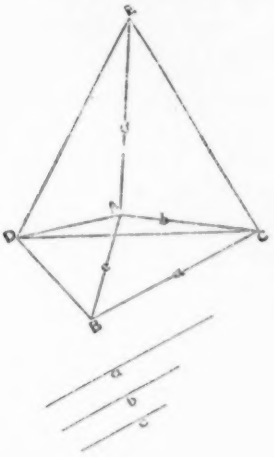
where F denotes the horizontal pull.

$$\therefore F = \frac{Wa}{h}.$$

Strathclyde.—Show how to construct an equilateral triangle, having given three lines severally equal to the distances from its angular points to a point within it.

State the conditions that must be satisfied by the three given lines in order that the construction may be possible.

(Science and Art Mathematics, 1884.)



Let a, b, and c be the three given straight lines. Construct the triangle ABC, having its sides BC, CA, AB respectively equal to the three given lines a, b, c. On AB describe the equilateral triangle ADB. Join CD. On CD describe the equilateral triangle CDE. Then CDE shall be the required equilateral triangle. Join AE. Because AD = BD, and ED = CD, therefore ED, DA = CD, DB each to each, and the $\angle$ EDA = the $\angle$ CDB (for each of these angles is less than the angle of an equilateral triangle by the common angle ADC). Therefore AE = BC (Euc., I. 4). Hence an equilateral triangle CDE has been constructed having its angular points distant from a point A within it by lengths severally equal to the three given lines a, b, c.

From the construction it is obvious that any two of the lines a, b, c must be greater than the third. Using the same figure, let A be any point within the equilateral triangle CDE, and let AC, AE, AD be drawn to the angular points of CDE. Upon AD describe the equilateral triangle ADB. Join BC. Then, as above, we may prove BC = AE. Hence the given lines must be such as will form a triangle—that is, the sum of any two of them must be greater than the third.

The following solutions can be obtained by post on application:—*Electron, F.W.T., Arum, A. D. Lampitt, J. B. Holmyard, Bike, Carrett, Peto Lucem, Puzzled.*

SECONDARY EDUCATION IN QUEENSLAND.—There are ten grammar schools in Queensland—six for boys and four for girls. Each school is governed by a board of seven trustees appointed by the Government, and of these four are nominated by the Governor-in-Council, and the others by a majority of the subscribers to the funds. The trustees hold office for three years, and are eligible for re-election. They are empowered to make regulations for the filling up of all vacancies that may occur in their number for the unexpired portion of the term of office, for the determination of fees to be paid by the scholars, for the salaries to be paid to the teachers, and generally for the management, good government, and discipline of the school. All such regulations are subject to the approval of the Governor-in-Council. Endowment at the rate of £1,000 per annum is paid by the state to each grammar school, making a total endowment of £10,000 annually to such schools. On the 31st December 1900 the aid granted by the state from the first institution of grammar schools reached a total of £266,535, 9s. 11d. A short Act amending the Grammar Schools Amendment Act was assented to during the year, which makes provision for the state inspection of grammar schools.

OUR SCIENCE SECTION

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

Sun-Spots in 1902.—During 1902 the surface of the sun was unusually quiescent. According to the eleven-year period, it was generally supposed that the minimum of spots had been reached at the end of 1901, so that a renewal of activity was confidently expected for 1902. On March 3rd a small group of spots passed the central meridian, and one or two faint spots were seen on the north-eastern limb, both groups being in the high latitude of + 25. In May another group of spots appeared; but, taken as a whole, the first eight months of 1902 showed fewer spots than any year since 1879. In September, however—namely, on the 18th—a group of spots began to form, and two or three days later two other groups formed on the eastern limb, so that there was promise of renewed activity in earnest. Professor Newcomb anticipates that the maximum spot period may be expected any time between 1904 and 1909.

Hypothesis based on Sun-Spots.—Mr. J. M. Haig makes the following remarks in a letter to the editor of *Knowledge*, on the sun-spots referred to above, and on those that followed them in October and November:—

"From a study of the great solar outburst of last September, and the subsequent disturbances of October and November, I have been led to observe certain curious coincidences—to use no stronger term—in regard to the position of some of these disturbances and the order of their appearance on the solar disc. Thus the September outburst, which consisted of a chain of disturbances lying practically along a meridian, and extending from a high south latitude into the equatorial zone of the northern hemisphere, was followed early in October by a group of spots in the *northern* hemisphere, and at a distance in longitude of about 180°. Now, allowing an apparent or synodic rotation period of 26½ days to the latter group, and 27 days to the most important portion of the former, situated about south latitude 24°, we find that October and November gave us repetitions of the above phenomena in a portion of the disturbed area, and that each recrudescence *appeared* to affect a portion of the opposite hemisphere situated at the extremity of a diameter. The same rule also held good in regard to a group of faculæ independent of the above, and which, appearing toward the end of October in the southern hemisphere, had its *vis-à-vis* in November in the northern hemisphere. If these facts be something more than mere coincidences, do they not suggest the conclusion that in the displays of the last three months we were viewing some of the effects of eruptions deeply seated and powerful enough to shake the whole body of the sun, and to cause great waves to converge at their antipodes, and to excite other eruptions in turn?"

Through the Trade Winds.—The Meteorological Office intends to explore the upper regions of the air above the equator by means of kites and balloons sent up from ocean steamers. In this manner it is hoped to study the overlying and anti-trade winds, and to make a map of their course. It is only on the peak of Teneriffe that the anti-trade winds can be observed the whole year through. Their mean lower limit is at the height of 9,000 feet, and their height is greater in summer than in winter. In October this altitude sinks to 6,000 feet. We know that the anti-trade exists over the trades, at least in the North Atlantic and at the Sandwich Islands; but no one has found this upper current in Central America or in Ecuador, while the smoke of the highest volcanoes around Quito constantly indicates a strong wind from the east.

Connection between Earthquakes and Volcanic Phenomena.—Geologists are all becoming convinced that there is a close connection between earthquakes and volcanic disturbances. For example, with respect to the volcanic eruptions in the West Indies, it is well known that there was a fearful seismic disturbance in Guatemala on April 19th, which was apparently the forerunner of the disastrous activity of La Soufrière and Mont Pelée. Earthquake shocks were also experienced in Venezuela. It has recently been pointed out by Professor Milne that about fifty world-shaking earthquakes occur each year, and that most of these have their origin near the steepest flexures on the surface of the earth. They are, in many cases, submarine, originating in furrows which become deepened at the same time that the neighbouring ridges become elevated, the result being that the rocks are in a state of tension, and therefore disturbance is likely to occur. A sudden snap underground causes an earthquake, which may open up new fissures or widen old ones, and so lead to volcanic phenomena. The Lesser Antilles, including Martinique and St. Vincent, are apparently placed on a curved fissure along the flanks of a rock-fold, and the readjustment of the fold, accompanied by the settling of the rocks along old lines of weakness, may relieve the pressure at the volcanic focus and so produce an eruption. In the opinion of Professor Milne, the 10,000 minor earthquakes occurring annually have no sensible relation to volcanic activity.

The Origin of Alpine Valleys.—Professor Bonney contends that the erosion of the valleys of the Alps is the effect mainly of running water and not of glaciers, which acted, according to the professor, for only a comparatively short time, and produced merely superficial effects. The main point round which the discussion of this point has turned is the origin of the so-called "hanging valleys," as the side valleys that enter the main valleys at a different level are called. Professor Bonney holds that differential pressure by means of streams was the sufficient cause of these; but Professor Garwood contends that an elevation of the land may have taken place, and may have increased the erosive action along the trunk valley, whilst the high lateral valleys may have been partially protected by ice.

Professor Tempest Anderson and the Pelean Eruption.—In a lecture delivered at the Royal Institution, Professor Anderson thus describes ordinary volcanic phenomena, and the modifications of them that obtained in the West Indian eruptions:—

"The accepted mechanism of a volcanic eruption is that a molten magma rises in the volcano chimney. It consists of fusible silicates and other more or less refractory minerals, sometimes already partly crystallised, and the whole highly charged with water and gases, which are kept in a liquid state by the immense pressure to which they are subjected. When the mass rises nearer the surface and the pressure is diminished, the water and gases expand into vapour and blow a certain portion of the heavier and less fusible materials to powder, or, short of this, form pumice-stone, which is really solidified froth, and they are violently discharged from the crater. When the greater part of the steam and gases has been discharged, the lava, still rising, gets vent either over the lip of the crater or often through a lateral fissure, and flows quietly down the side of the mountain.

"It is quite recognised that these phenomena may occur in various relative proportions. We believe that in these Pelean eruptions the lava which rises in the chimney is charged with steam and gases, which explode as usual; but some of the explosions happen to have only just sufficient force to blow the mass to atoms, and lift the greater part of it over the lip of the crater without distributing the whole widely in the air. The mixture of solid particles and incandescent gas behaves like a heavy liquid, and before the solid particles have time to subside, the whole rolls down the side of the mountain under the influence of gravity, and consequently gathers speed and momentum as it goes. The heavy solid particles are gradually deposited,

and the remaining steam and gases, thus relieved of their burden, are free to ascend."

Erosion of the Coast.—In few places round the coast are the inroads of the sea more noticeable than near Selsey, on the Sussex coast, and the Rev. G. C. Walpole, vicar of West Wittering, urges that the time has come when the Government should take serious steps to combat the disappearance of some of the best agricultural land in England. Fifty years ago, he says, the western boundary of Wittering was so close to Hayling Island that a chain was stretched across, to which a ferry-boat was attached, and at low tide horses could ford the intervening water; but now Sussex is parted from Hampshire by a mile or more of salt water at the mouth of Chichester harbour, which becomes noticeably wider after every severe storm. The manor of Cadcham, which consisted of 800 acres but two hundred and fifty years ago, has so suffered that now it is less than 300 acres, 500 acres having been swallowed up. Some groining has been done within the last two years by the Ecclesiastical Commissioners who administer the manor, but Mr. Walpole says that it is not sufficiently defensive against the violent attacks of the sea. On the east coast the matter is even more urgent. At the conference held at Norwich recently, at which the representatives of eleven local authorities as well as many landowners attended, the town clerk of Lowestoft declared that at the present rate of erosion the sea would, in a comparatively few years, flood the country up to Beccles, and even to Norwich, twenty miles inland. The cliffs had been eaten away to such an extent that there remained only a narrow belt between the sea and vast areas of low-lying lands.

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Purification of Hydrochloric Acid from Arsenic.—In the estimation of arsenic by the Marsh-Berzelius test, the use of hydrochloric acid is admittedly preferable to that of sulphuric acid. It is, however, practically impossible to purchase hydrochloric acid really free from arsenic, and it is therefore necessary to remove the last traces of arsenic from it in the laboratory.

The method recommended in the report of the Joint Committee of the Society of Chemical Industry and of Public Analysts (*Analyst*, 1902, xxvii., 48), namely, that of treatment of the diluted acid with hydrobromic acid or bromine and sulphurous acid and subsequent distillation, is successful in most cases, but occasionally fails, the arsenic then appearing to be present in a very stable or resistant form. Under these latter conditions, satisfactory results are said to be obtained if the hydrobromic and sulphurous acids are added to the *strong* hydrochloric acid, and the excess of hydrochloric acid gas boiled off before distillation commences. If large quantities of hydrochloric acid are wanted, this method is inconvenient and wasteful, owing to the large quantities of hydrochloric acid gas evolved.

The whole of the arsenic may readily be removed by means of a modification of the well-known Reinsch test for arsenic, in the following manner:—

The hydrochloric acid to be purified is diluted with water till its specific gravity is about 1·10, then raised to the boiling point, and a piece of fine copper gauze introduced. The gauze should be of about 100 meshes to the inch, and of as pure copper as possible. When a couple of litres of liquid are being dealt with, the gauze should be about four inches square and coiled very loosely (about 1½ to two turns) round a long glass rod flattened at the end, as in this way it can be readily introduced and removed, besides being brought into better contact with the liquid. The whole is then kept just boiling for an hour. By this time the gauze will have become more or less blackened, and should be replaced by a second piece, and the digestion continued for another hour. If this piece is also blackened, a third is used, and so on, until the gauze remains perfectly bright after about an hour's digestion. With moderately good acid, two, or at most three, pieces of gauze are sufficient. The gauze is then removed, and the acid at once transferred to a retort, and distilled from a fresh piece of gauze. It is advisable, as a precaution, to reject the first 20 per cent. of the distillate, though even this is very rarely contaminated if the digestion is carefully carried out, and from 100 to 200 cubic centimetres should be left behind in the retort. The method is simple, and requires but little attention, and it is not necessary to use the purest acid; even good muriatic acid, "commercially free from arsenic," may be satisfactorily employed. The acid obtained is the constant boiling-point acid, which is about the most suitable strength for use in the Marsh-Berzelius test.

The gauze must, of course, be gently ignited before being used, and should not be introduced until the acid is just beginning to boil. It is also preferable not to allow the digested liquid to cool in contact with the air before transferring to the retort, as the copper gauze would be much attacked, and its efficiency for the present purpose considerably lessened, by the consequent oxidation.

Making Rubies with Aluminium.—At the last meeting of the French Academy of Sciences, M. Moissan showed a beautiful large ruby, which seemed as pure as a natural ruby, and explained its manufacture. He first melted some alumina, which he then coloured with oxide of chromium, this being necessary in order to reproduce the formation and the exact chemical composition of the natural ruby. Several small stones were thus manufactured, but no really fine ruby was produced until, instead of melting the alumina, he brought it to a temperature very close to the melting point, and kept it there during the entire operation. This he obtained by throwing on the softened alumina some pulverised aluminium mixed with oxide of chromium. An expert says that the stones obtained are formed of an agglomeration of numerous crystals, whereas every genuine ruby is composed of a single crystal, and, therefore, a microscopic examination will always enable experts to distinguish the artificial from the genuine.

Activity of certain Salts of the Rare Earths as Oxidisers (André Job).—The spontaneous oxidation of potassium-cerium carbonate, and the oxidations resulting from contact with it, is so marked that the author further examines this type of phenomena. Other salts of cerium exhibit the same reactions, and it is found that for atomic equivalent quantities cerium acetate has an activity at least as great as manganese acetate itself. Cerium acetate is a very stable salt; its solution when exposed to the air remains limpid and colourless, and shows no sign of spontaneous oxidation. In the course of his experiments the author finds a quite unexpected example of similar activity in the case of lanthanum, and a result of his experiments is that undoubtedly there exists a peroxide of lanthanum, a hitherto undiscovered fact. At present it is not certain whether or not this oxide corresponds to the hydrate precipitated by hydrogen peroxide. He is continuing his investigations on this matter.

Preparation of Chlorine by means of Permanganates.—Herr C. Graebe has experimented with both commercial and crystallised permanganate of potassium, as well as with permanganate of calcium, which is easily soluble. As a result of his experiments, he finds that when it is required to prepare small quantities of chlorine, the use of permanganate is very convenient, especially in cases where the presence of peroxide of chlorine would be objectionable; for its preparation on a large scale, the chlorate of soda method is preferable when the presence of the peroxide is not of importance. To prepare chlorine by means of permanganate, the same apparatus is used as with the chlorate of sodium method. Solid permanganate is placed in a flask, and concentrated hydrochloric acid is dropped on to the salt very gradually. The operation is commenced in the cold, then heat is applied when half the necessary amount of hydrochloric acid has been added. To get off all the chlorine, it is necessary to use an excess of hydrochloric acid, and experience shows that about ten molecules of acid are necessary for each one of permanganate, instead of the eight required theoretically. When the operation is properly carried out, almost the theoretical amount of chlorine is obtained.

The Formation of Dithionic Acid.—Herr J. Meyer explains the preparation of the dithionates in the following manner:—The action of SO_2 on MnO_2 does not at first produce either free dithionic acid or MnO, or sulphate of binoxide of manganese, but instead manganic sulphite (of the sesquioxide) and free oxygen. The manganic sulphite is then split up into dithionate and manganous sulphite—

$$2MnO_2 + 3SO_3H_2 = (SO_3)_3Mn_2 + 3H_2O + O.$$
$$(SO_4)_3Mn_2 = S_2O_6Mn + SO_3Mn.$$

In fact, he has observed analytically the presence of sulphite in the products of the reaction done in the cold. If this interpretation is correct, the hydrates of the sesquioxides (being able to form protoxides) of iron, cobalt, and nickel, suspended in water, and treated with a current of SO_2 at about 0°, ought to form first a sulphite of the sesquioxide, which will then decompose as above into hyposulphate and sulphite of the protoxide. Experiments have shown that this is the case. For instance, with $Fe_2(OH)_6$, we first obtain a deep red liquid (ferric sulphite), which soon becomes decolourised, and gives a very good yield of dithionate. On the other hand, PbO_2 does not react on SO_2 in the presence of cold water; HgO is the same. As for the other

binoxides, BaO_2, MgO_2, Na_2O_2, and H_2O_2, when treated with SO_2, they give H_2SO_4 directly in the cold. The examination and study of the electric conductivity, and the cryoscopy of the solutions of dithionates, confirm the opinion that the molecule of dithionic acid is indeed $S_2O_6H_2$.

New Colour Reactions with Boric Acid.—Messrs. Charles E. Cassal and Henry Gerrans find that an intense magenta-red colour is produced on treating solutions containing boric acid with curcumin—or ordinary turmeric itself—and oxalic acid, and drying the mixture on the water-bath. The colour is different from that obtained by the application of the ordinary turmeric test for boric acid, and the reaction is far more delicate, extremely minute quantities of boric acid being easily detected. The colour is practically permanent for several hours—not less than ten or twelve—and fades very gradually on long keeping. The colouring matter is readily soluble in alcohol and ether without alteration, but is destroyed by the addition of water in excess. On treatment with alkali an intense blue colour is obtained, which is different from that obtained on treating the "rose-red," colouring matter formed in the ordinary turmeric test, with alkali. In applying the test for the detection of free or combined boric acid in milk and other food products, it is convenient, as a rule, to operate on an ash. The ash is treated with a few drops of (1) dilute hydrochloric acid, (2) saturated solution of oxalic acid, and (3) alcoholic solution of curcumin or turmeric, and the mixture dried on the water-bath and taken up with a little alcohol. In cases where the amount of boric acid is very small, the substance, the ash of which is to be operated upon, should be made alkaline with solution of barium hydroxide prior to evaporation and incineration. Caustic potash and caustic soda and salts of potassium and sodium in *large* amounts interfere with the formation of the colouring matter. The authors have successfully applied the test for the purpose of estimating boric acid.

A New Preparation of Silicon Hydride, Si_2H_6 (Henri Moissan).—When lithium silicide is gently heated in a current of dry hydrochloric acid gas, a certain amount of hydrogen is produced, as well as chlorides of lithium and silicon. If, on the contrary, a concentrated solution of hydrochloric acid ($HCl + 2H_2O$) is allowed to act slowly on the lithium silicide, siliciuretted hydrogen (Si_2H_6) is formed in abundance, and this can be condensed by allowing it to pass into liquid air at $-200°$.

A New Method of Estimating Hydroxylamine Volumetrically (L. J. Simon).—The author believes that up to the present time there has been no satisfactory method of estimating hydroxylamine, and so he devises a volumetric estimation founded on the particular action of permanganate of potash on the oxalate of hydroxylamine. The latter is a well-known crystalline and anhydrous salt, which can easily be obtained in a pure state owing to its slight solubility in water. The action takes place in two phases, the first being expressed by the equation—

$$2MnO_4K + 4[C_2O_4H_2(NH_2OH)] = 2C_2O_4Mn + 2C_2O_4KH + N_2O + 6N + 15H_2O,$$

and in the second phase in presence of sulphuric acid the oxalic acid is oxidised in the ordinary manner, evolving carbon dioxide. Very good results were obtained by this method.

THEORETICAL MECHANICS.

(ADVANCED AND HONOURS STAGES.)

BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Calculation of Work.—Methods have already been indicated by which the work done by a given force can be obtained. The processes applied to the various simple machines should be carefully made out. When, as in *virtual work*, the displacement takes place through a *small distance*, the virtual work of all the components of a given system of forces is equal to the virtual work done by their resultant, and the total work done by all the forces is zero.

If A denotes the area of cross section of a rod or wire, one end of which is suspended from a fixed support, the other carries a load W lbs., then

$$\text{Stress} = \frac{\text{load}}{\text{area}} = \frac{W}{A}.$$

Accompanying the stress, and produced by it, there is an alteration in the length, the strain denoting the ratio of the alteration in the length to the original length.

$$\therefore \text{strain} = \frac{\text{alteration in length}}{\text{original length}}.$$

It is found that in all elastic materials within a certain limit known as the *elastic limit*, the strain produced is always proportional to the stress. Thus, if a load of 1 ton produces an extension of 0·1 inch, then a load of 2 tons would produce an extension of 0·2 inch, etc. Hence stress = strain multiplied by a constant, and the relation is usually written—

$$\frac{\text{stress}}{\text{strain}} = E, \quad \ldots\ldots\ldots \quad (1)$$

where E is a constant, called the *modulus of elasticity* for the given material. E is also called *Young's modulus*.

If the alteration of length produced by a force F is x, then the work done in extension or compression is $\frac{1}{2}Fx$.

The value of E for a given material may be found by supporting a rod or bar at its two ends on knife edges, applying a load W at the centre, and reading by means of a microscope or other accurate method of measurement the deflection at the centre or middle point of the rod. If D denotes the deflection produced, then $D = \frac{Wl^3}{48EI}$, where l is the length between the supports, E is Young's modulus, and I denotes the moment of inertia of the bar. If the bar is rectangular, the equation becomes $E = \frac{Wl^3}{4bd^3D}$, since $I = \frac{1}{12}bd^3$. If a cylindrical bar is used, the value of I for a circular section must be used.

Ex. 1. (*a*) If the modulus of elasticity is defined as the ratio of longitudinal stress to strain, what is the meaning of the words stress and strain?

(*b*) A rod 15 feet long, with a uniform cross section of 6 square inches, is hung up by one end, and carries a weight of 30 tons at the other; it is thereby stretched a quarter of an inch. Find the numerical values of the stress, strain, and E. (1893.)

(*b*)
$$\text{Stress} = \frac{\text{load}}{\text{area}} = \frac{30}{6} = 5 \text{ tons per sq. in.}$$

$$\text{Strain} = \frac{\frac{1}{4}}{15 \times 12} = \frac{1}{720}.$$

$$E = \frac{5}{\frac{1}{720}} = 5 \times 720.$$

$$= 3600 \text{ tons per sq. in.};$$

or, multiplying by 2240, the answer may be expressed in pounds per square inch.

The tensile strength of a given material can be ascertained either by means of a so-called testing machine or by the preceding methods. The pressure sufficient to burst a cylinder or a sphere can be obtained when the tensile strength of the material is known.

Tension of a thin Cylinder under Internal Fluid Pressure.—Let r denote the radius of a cylinder, and l its length. The area of a diametral plane will be $2r \times l$. If p is the internal pressure, then the magnitude of the resultant pressure on one side such a plane is $2rl \times p$. This force is balanced by the parallel forces furnished by the edges of the rectangle. If T denotes the thickness of the cylinder, f the tenacity or tensile strength of the material of which the cylinder is made, then the greatest tension along the edges of the rectangle is Tfl on each side, and therefore $2Tfl$ for the two sides. Hence, equating, we obtain—

$$p \times 2rl = 2Tfl.$$
$$\therefore pr = Tf,$$
$$\text{or } p = \frac{Tf}{r}. \quad \ldots\ldots\ldots \quad (1)$$

In some cases, especially when the thickness is very small, it is convenient to take, instead of the thickness T and the tensile strength f, the tension t per unit length.

Then, as in Eq. (1),

$$p \times 2rl = 2tl.$$
$$\therefore t = pr.$$

In the case of a sphere of radius r, a diametral plane will cut the sphere in a great circle; its area will be πr^2. If, as before, p denotes the internal pressure, then the magnitude of the resultant pressure on one side such a plane will be $p \times \pi r^2$.

If T denote the thickness of the material, then the resistance

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to fracture will be furnished by a ring of length $2\pi r$ and thickness T. Hence, equating—

$$2\pi r \mathrm{T} f = \pi r^2 p.$$

$$\therefore p = \frac{2\mathrm{T}f}{r} \quad \ldots \ldots \ldots \quad (2)$$

Comparing this with Eq. (1), the bursting pressure for a sphere is seen to be double that of a cylinder of same radius. As in the case of a cylinder, instead of the thickness T and the tensile strength f, we may denote by t the tension per unit length. Then, as before, along the circumference of a great circle there will be tensions perpendicular to the plane of the circle, and the resultant of all the tensions will be $2\pi rt$.

$$\therefore 2\pi rt = \pi r^2 p.$$
$$\text{or } t = \tfrac{1}{2} pr.$$

Ex. 2. A bar of metal, whose cross section is a square inch, is supported by one end, and can just support a weight of 12,000 lbs. hanging from the other end of it. A hollow sphere, whose radius is a foot and thickness one-fifth of an inch, is made of the metal. Find the internal fluid pressure that will just burst it. (1895.)

Here, in the formula

$$p = \frac{2\mathrm{T}f}{r},$$

$$\mathrm{T} = \tfrac{1}{5} \text{ inch}; \; f = 12000 \text{ lbs.}; \; r = 12 \text{ in.}$$

$$\therefore p = \frac{2 \times 12000}{5 \times 12}$$

$$= 400 \text{ lbs. per sq. in.}$$

Ex. 3. Find the tension at any point of a thin flexible spherical envelope subjected to an internal fluid pressure which is the same at all points. Let the sphere have a radius of 30 feet, and let the pressure at any point be 0·75 lb. per square inch. Compare the tension at any point with that of a ribbon a quarter of an inch wide that carries a weight of 25 lbs. (1901.)

Radius of sphere = $30 \times 12 = 360$ inches, and as p is ·75 lb., if t denote the tension per unit length, then

$$t = \tfrac{1}{2} \times 360 \times \cdot 75$$

$$= 135 \text{ lbs. per in. length.}$$

$$\text{Tension in ribbon per in. length} = 25 \times 4 = 100 \text{ lbs.}$$

$$\text{Hence } \frac{\text{tension in material of sphere}}{\text{tension of ribbon}} = \frac{135}{100} = 1 \cdot 35 : 1.$$

Soap Bubble.—To balance the surface tension of the film in a soap bubble which tends to make the bubble contract, the inside pressure must be greater than the external. Let p denote the excess of the internal over the external pressure, and let r at any instant denote the radius of the sphere, then, as in the preceding case, if we assume an imaginary plane to pass through the centre of the sphere, the area of such a plane will be πr^2, and the resultant force on one side such a plane will be $p \times \pi r^2$.

The total tension on the outside of the film will be $t \times 2\pi r$, where t is the tension per unit length along the circumference; and as there is a corresponding surface tension from the inside of the film, the total force will be—

$$2t \times 2\pi r = 4\pi tr.$$

$$\text{Hence, equating, } p \times \pi r^2 = 4\pi tr.$$

$$\therefore p = \frac{4t}{r} \quad \ldots \ldots \ldots \quad (3)$$

From (3) it follows that p diminishes as r increases, or the internal pressure multiplied by the radius at any given instant is constant. The surface tension can be ascertained by estimating the internal pressure and the radius.

Boyle's Law.—The diagram of work for a variable force may be set out by marking off along a horizontal line distances denoting displacements, and at each point a line denoting by its length to scale the magnitude of the force. The extremities of the lines so obtained may be joined, forming a curve; the area between the curve and the two axes is the work done by the force. As a simple example, the force or pressure exerted by a gas, assumed to vary according to Boyle's Law—that is, for a *given quantity of gas the force exerted varies inversely as the volume, the temperature remaining constant*—then if horizontal distances or abscissæ are taken to represent volumes and ordinates the corresponding pressures, the curve passing through the points so obtained is called a *rectangular hyperbola*. If p and v denote the pressure and volume respectively at any point on the curve, and $p'v'$ the corresponding pressure and volume at any other point, then the relation is $pv = p'v'$. . . . . (i).

Let p be 50 and v be 2, then given either p' or v', the remaining term can be obtained. Thus if v' is 4, then from (i) $p' = 50 \times 2 \div 4 = 25$.

If the relation between p and v is expressed by pv^n = constant, then the area of the curve is known from mensuration to be $\frac{p_1 v_1 - p_2 v_2}{n-1}$ where p_1 is the pressure when the volume is v_1, and p_2 is the pressure when the volume is v_2.

The formula fails when $n = 1$ and the equation becomes pv = constant. This corresponds to *Boyle's Law* or *isothermal expansion*, and may be taken to be a special case of $pv^n = c$; and the area of the curve denoting the work done is obtained from $pv \log_e \frac{v_2}{v_1} = pv \log_e r$, where r denotes the ratio of v_2 to v_1.

Ex. 4. Investigate the work done by the pressure of a gas contained in an expansible envelope in isothermal expansion. Calculate the work done when 1,000 cubic feet of gas expand to 1,050 cubic feet in an expansible envelope, the initial pressure being 2,000 pounds weight per square foot. (1901.)

$$\mathrm{Log}_{10} 105 = 2 \cdot 021; \; \log_{10} e = 0 \cdot 434.$$

$$\text{Work done} = pv \log_e r.$$

Substituting the given values, this becomes—

$$2000 \times 1000 \log_e \frac{1050}{1000}.$$

$$\therefore \text{work done} = 2000 \times 1000 \log_e 1 \cdot 05.$$

$$\text{Also } \log_e 1 \cdot 05 = \log_{10} 1 \cdot 05 \times 2 \cdot 3026$$

$$= \log_e 1 \cdot 05 \div \frac{1}{\cdot 434}.$$

$$\text{Work done} = 2000 \times 1000 \times \cdot 04835$$

$$= 2000 \times 48 \cdot 35$$

$$= 97700 \text{ ft.-pds.}$$

Ex. 5. When a gas expands without change of temperature, show that the external work done is given by the formula $pv \log (v_1 \div v)$, and explain the notation.

State what units must be employed if the formula is to give the work in foot-pounds, and justify the statement. (1902.)

Ex. 6. A thin cylindrical vessel is filled with a substance which exerts an internal pressure p, and is closed. Find the longitudinal pull per unit of length across a circumferential section, the diameter of the cylinder being d. (1900.)

Ex. 7. Determine the stresses set up in the material of a spherical vessel subjected to internal fluid pressure. A volume v of air at pressure p is to be carried in n, equal spherical vessels of radius r, and the working tension of the material is not to exceed t. Find the thickness of the vessels; express also the whole volume of metal in terms v, p, and t, and show that there is a saving of 25 per cent. over the cylindrical shape if the ends be neglected. (1902.)

Ex. 8. If a gas expands according to the law pv^s = constant, show that the work done in its expansion from a volume v_1 to a volume v_2 is—

$$\frac{p_1 v_1}{s-1}\left\{1 - \left(\frac{v_1}{v_2}\right)^{s-1}\right\}$$

where p_1 is the pressure corresponding to v_1. What is the result when s has the value unity? (1902.)

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practically the full brush voltage of the dynamo across their terminals, while those at the far end of the mains would have a voltage less than this by the drop in the mains; thus, if the voltage across the distant lamps were maintained constant, that across the lamps near the dynamo would rise with the current, and the filaments would shortly be destroyed. Further, a source of loss would still remain even if this difficulty could be overcome.

The rate of loss of energy in the mains is equal to C^2R, where C is the current, and R is the total resistance of the mains. Let us suppose that a certain number of lamps are arranged across the ends of the mains, and the dynamo is wound so as to keep the voltage V across their terminals constant, however many of these lamps are thrown into the circuit. Then, when the lamps in circuit require a total current C, the rate at which energy is being utilised is equal to CV, while the rate at which energy is being wasted in heating the mains is equal to C^2R. The ratio of the rate of waste of energy to the rate of utilisation of energy is equal to

$$\frac{C^2R}{CV} = \frac{CR}{V} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

Now let us suppose that double the number of lamps are thrown into the circuit. We shall now require a current equal to 2C, and, since the voltage across the terminals of the lamps is supposed to remain constant, the rate of utilisation of energy is equal to 2CV—that is, twice that in the previous case. The rate at which energy is being wasted in heating the mains is equal to

$$(2C)^2R = 4C^2R,$$

that is, *four* times that in the previous case. The ratio of the energy wasted to the energy utilised is now twice as great as before, and the method of distribution is by so much the less economical. It is plain that if the number of lamps were increased indefinitely, nearly all of the generated energy would be wasted, and only a small fraction usefully employed.

Equation (1) indicates that, with mains of a given resistance, the ratio of the energy wasted to the energy utilised may be diminished by increasing the potential across the terminals of the lamps. Of course, the lamps must be constructed for the special voltage decided on: a 16 candle-power lamp requires about 3 watts, which may be supplied by $\frac{1}{4}$ ampère at 100 volts, or $\frac{1}{8}$ ampère at 200 volts. Thus for a given number of 16 candle-power lamps, the current required at 200 volts will be equal to half that required at 100 volts, so that if the loss of energy in the latter case is equal to C^2R, the loss in the former case will be equal to

$$\left(\frac{C}{2}\right)^2R = \frac{C^2R}{4}.$$

Thus a high voltage system of distribution is more economical than one at a low voltage. There are, however, practical considerations which limit this method of economising. Very high voltage systems need extremely good insulation, and may produce fire or loss of life. Further, there are practical difficulties in constructing glow-lamps for very high voltages. A 16 candle-power glow-lamp requires, as stated above, about $\frac{1}{8}$ ampère at 200 volts, and the resistance of its filament must therefore be equal to about 800 ohms. To obtain this high resistance, the filament must be made either very long or of very small sectional area. The sectional area cannot be diminished below a certain point, or the filament becomes liable to breakage from mechanical vibrations. The length of the filament is limited by the circumstance that it must be enclosed in a fairly small glass vessel, and therefore it is doubtful whether lamps will ever be made with filaments much longer than at present. Thus it is improbable that ordinary glow-lamps could be made for voltages *very much* higher than 200 volts. At present, 200 volt lamps are rapidly superseding 100 volt lamps.

Another method of economy now suggests itself. Instead of arranging the lamps in parallel across the mains of a 200 volt circuit, we might arrange them across a 400 volt circuit, each lamp being constructed for 200 volts, and placed in series with

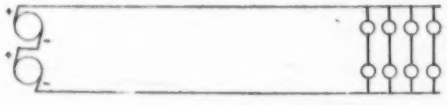

Fig. 1.

another similar lamp. (Fig. 1.) In this case the current required would be equal to only half that necessary if they were all arranged in parallel, and the loss of energy would be only one quarter that in the latter case. This system, however, labours under the disadvantage that one lamp cannot be turned out without turning out its fellow, and is therefore of little general use.

The Three-Wire System.—The difficulty just discussed may be overcome by the use of a device invented by the late Dr. Hopkinson when a student at Cambridge. Two dynamos are coupled in series, and three mains are used, connected to the

Fig. 2.

dynamos in the manner shown in Fig. 2. We now have two circuits, one for either dynamo, the middle (or neutral) wire forming part of each. If the same number of lamps is connected across each circuit, there will be no current along the middle wire, and the conditions are virtually the same as in Fig. 1. We may now, however, turn out any lamp we please without interfering with any other, the small out-of-balance current flowing along the middle wire. It is easy to determine the current in the middle wire. We may suppose that the current C_1, necessary for the lamps in the upper circuit, flows *from right to left* along the middle wire, while the current C_2, necessary for the lamps in the lower circuit, flows *from left to right* along it. Then the actual current in the middle wire is equal to $C_1 - C_2$, flowing from right to left, or $C_2 - C_1$, flowing from left to right. It thus becomes apparent that, when the two circuits contain approximately equal numbers of lamps (or are equally loaded), the current in the middle wire will be small. In practice it is generally arranged that if one house in a street is connected across one of the circuits, the next house is connected across the other circuit, so that approximate equality of load is obtained. The middle wire can then be made of smaller sectional area than either of the outer wires, since the current in it will always be small, and the drop of potential in it will be inconsiderable.

Problem.—The electric lighting of a block of buildings is effected from an engine-room 1,350 yards distant. The wiring of the block is arranged for the three-wire system, and is fed by a three-wire feeder, the cross-sectional areas of the conducting cores of which are 0·5, 0·25, and 0·5 square inch respectively. There are 700 lamps of 16 candle-power in use on the circuit, connected with one side of the system, and 550 lamps on the other side. What voltages must be maintained at the generating station ends of the feeder between the positive and negative conductors and the neutral respectively, in order that the pressure between the terminals of each of the distributing circuits may be 205 volts? The current required by each 16 candle-power lamp may be taken as 0·3 ampère, and the resistance of a cubic inch of copper at 0·66 microhm.

Here the conducting core of 0·25 square inch sectional area corresponds to the middle (or neutral) wire (Fig. 2). Let the upper circuit be the one with 700 lamps; then

$$C_1 = 700 \times 0{\cdot}3 = 210 \text{ ampères};$$
$$C_2 = 550 \times 0{\cdot}3 = 165 \text{ ampères}.$$

Thus the current in the neutral wire flows toward the generating station—that is, from right to left in Fig. 2—and is equal to $C_1 - C_2 = 45$ ampères.

Resistance of either outer wire =

$$\frac{0{\cdot}66 \times 10^{-6} \times 1350 \times 36}{0{\cdot}5} = 0{\cdot}064 \text{ ohm}.$$

Since the sectional area of the neutral wire is half that of either of the outer, its resistance is double that of one of the outer—that is, 0·128 ohm. Let V_1 be the voltage across the brushes of the upper dynamo (Fig. 2). Then V_1 must be equal to the drop in the upper wire ($C_1 \times 0{\cdot}064$), *plus* the voltage across the lamp terminals (205 volts), *plus* the drop along the neutral wire, due to the current ($C_1 - C_2$) flowing from right to left. Thus,

$$V_1 = (210 \times 0{\cdot}064) + 205 + (45 \times 0{\cdot}128) = 13{\cdot}4 + 205 + 5{\cdot}8$$
$$= 224 \text{ volts (nearly)}.$$

Let V_2 be the brush voltage of the lower dynamo. Then V_2 must be equal to the total drop of potential in going round the lower circuit from the + to the − brush of the dynamo. Note that in going along the middle wire we proceed against the current, so that the potential *rises*. Then

$$V_2 = -(45 \times 0{\cdot}128) + 205 + (165 \times 0{\cdot}064)$$
$$= -5{\cdot}8 + 205 + 10{\cdot}6 = 210 \text{ volts (nearly)}.$$

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Plato's Euthyphro. By William Arthur Heidel, Ph.D., Professor in Iowa College. Professor Heidel was led to undertake the editing of this book by his dissatisfaction with the prevalent custom of beginning the study of Plato with the *Apology*. After experimenting with some of the other dialogues, he finally fixed upon the *Euthyphro* as the most suitable as an introductory study. The book contains an excellent introduction, giving a short account of Plato and Socrates, and a more elaborate description of the place that the *Euthyphro* takes among the Platonic dialogues. There are plenty of notes full of sound scholarship on the matter and the form of the dialogue, and there is a comprehensive piece of bibliographical work at the end. The whole tone of the book suggests that it is the work of an enthusiast as well as of a critic.

A Grammar of Attic and Ionic Greek. By Frank Cole Babbitt, Ph.D. (Harvard). Professor Babbitt's book is intended for secondary schools and also for colleges. The Attic forms are given in clear type in the ordinary text, while the Ionic forms and uses are printed in footnotes—*τύπτω* and *λέω* have both given place to *παιδεύω* as the typical verb. In the syntax the examples are printed in the same type as the rules and exceptions which they illustrate. We are not quite sure that this does really produce the effect, which Professor Babbitt claims for it, of making the examples clearer. Wherever we have tested the book we have found it thoroughly satisfactory. One of the best things in it is the list of important Greek grammars which is given in the preface.

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E. J. ARNOLD AND SON.

Notes on Physiography. By W. J. Stainer, B.A., F.C.S. Mr. Stainer has drawn up his notes very clearly, and Messrs. Arnold have displayed them well. For a teacher to lecture from the notes will be very useful, but as respects the use of them by students we have our doubts. We believe that the student should draw up his own notes, and that the days of epitomes for students are past.

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Puerorum Liber Aureus. By T. S. Foster, B.A. Mr. Foster has put together a very interesting little book, and we feel confident that any ordinary class of boys will enjoy working through it. The author has strung together accounts of the three first expeditions which the Romans made against Britain; and interwoven with these are short descriptions of the various peoples concerned, and scenes from the life of one "Marcus," who is supposed to be an Italian boy living in the reign of Claudius. One of the best points in the book is the fact that a boy who uses it will probably pick up an unusually large vocabulary. We wish, however, that the proofs had been corrected with a little more vigilance. Such words as "*descendum*," "*mutitudinem*," "*censisses*," and many others of the same sort, would then have been corrected.

English History Illustrated from Original Sources (1399 to 1485). By F. H. Durham. A valuable book if used to supplement a good historical text-book, but not calculated, as the editor claims for it, "to supply the place of a text-book." Used side by side with a really good history, these extracts from original documents will make events more real, and will sometimes show causes and consequences more conclusively than the ordinary text-book can do; and they will save time and trouble for those who have little leisure or opportunity for independent research.

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Xenophon: Anabasis, I. By C. E. Brownrigg, M.A., headmaster of Magdalen College School, Oxford. (Blackie's Illustrated Greek Series.) This is a reissue, with certain alterations and additions, of an earlier work. It is a thoroughly sound piece of editing, and has, so far as we can judge, but one fault—it seems in many ways a great deal too advanced for use in a class of "beginners." The discussion as to the precise scene of the battle of Cunaxa, for instance, is out of place in what professes to be an elementary text-book. The same remark, too, applies to the appendix on the construction of Greek sentences, though in itself this is an excellent piece of work. We wish that editors would get out of the habit of giving Greek verbs in the present *indicative* forms and their English equivalents in the present *infinitives*.

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Elements of English Composition. By John Hays Gardiner (Assistant-Professor of English in Harvard University), George Lyman Kittredge (Professor of English in Harvard University), Sarah Louise Arnold (Dean of Simmons College, formerly Supervisor of Schools in Boston). The reading of this book has left us with a somewhat mixed set of impressions about it. We should very much like to know whether it is intended simply as a help to teachers of composition, or is meant also to be used as a text-book for pupils. If the first supposition is correct, we gladly recognise that the book may be of very great service. It certainly contains good examples of various prose styles, which will serve as models for both teacher and pupils to study in detail. There are, again, many excellent hints and suggestions for incidental lessons on various points of interest and importance. But if the authors mean the book to be put into the hands of boys and girls and worked through as a class-book, then we have several most serious protests to make. Too many of the subjects suggested for exercises are "snatched out of the air," instead of being based upon the actual mental experience of the boys and girls themselves. We cannot help believing that such an exercise as the following—quite typical of many others in the book—is absolutely valueless for the purpose for which it is meant: "Make a list of twenty objects. Exchange lists with another pupil, and suggest adjectives which might be appropriately applied to the objects named in the list which you receive."

The book abounds also in platitudes. Here, for instance, is a caution solemnly given to those who would learn to excel in the art of "explanation": "Be particular, too, in the selection of words, for carelessness or inaccuracy in this respect may seriously obscure your meaning."

We object, further, very strongly to the appeal which is so often made to "the dictionary." Indeed, we think that this last point is most suggestive of the whole tone of the book. It teaches English as though it were a foreign language which had to be approached from the outside through rules of formal grammar.

Essentials of English Composition. By Horace S. Tarbell, LL.D. (Superintendent of Schools, Providence, R.I.), and Martha Tarbell, Ph.D. Nobody can have any excuse for not realising at once the value of this book, for the authors have been so kind as to let us all know precisely what we ought to think about it. In the preface they remark: "It is complete in its treatment of the practical features that underlie the art of composition." After reading this most satisfactory announcement we were still somewhat uncertain as to what a "practical feature" might be like, and how a "feature" of this or any other kind could "underlie" anything whatever. We turned, therefore, for information to the chapter on "Style," which, we are assured on the same authority, "contains the fundamental laws of good writing." Here—under the head of "mixed metaphors"—we found the statement that "a sentence which contains mixed metaphors is neither clear nor forcible, and should be carefully avoided."

The conception of English composition which the authors have formed is best illustrated by the fact that twenty-seven pages are given to "choice of words," and sixty to "punctuation."

The best thing in the book is the chapter called "A Study of Longfellow."

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Les Enfants du Luxembourg. Par Mme. Charlotte Charbier-Rieder. Illustré de 46 vignettes par Henri Zo. This is a pretty picture of child life in Paris, and will form a useful study of the manners and customs of that place for those of our young people who already know something of its language. The children are well drawn, though perhaps the English millionaire's daughter is a little too highly-coloured to be quite natural.

HODDER AND STOUGHTON.

Glengarry Days. By Ralph Connor, author of *The Sky Pilot*, *The Man from Glengarry*, etc. Those who have read *The Man from Glengarry* will find themselves in familiar scenes and among a people whose ways are not strange to them in reading this book. The great forests of Canada, with their thin sprinkling of settlers from the home land, or of the descendants of such, form the scene of a series of incidents dealing for the most part with school-life. And such a school as it is! Those who know only the schools of our cities and towns may be excused for thinking that here they have a caricature such as Kipling, for instance, might give; but the pictures are, we

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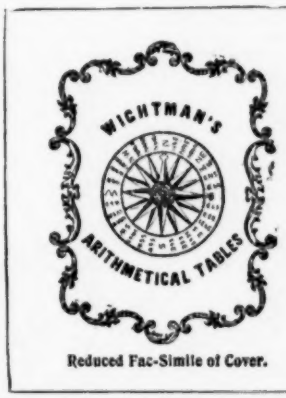

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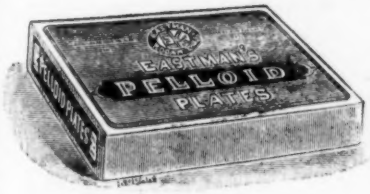

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